# QUALITY ASSURANCE PROJECT PLAN

## For

## CWA 319(h)
## Grant Agreement No. 12-412-259
## San Diego Region

## Nutrient Source Reduction Program in the Rainbow Creek Watershed Water Quality Monitoring

**Prepared by**

**County of San Diego**
**Watershed Protection Program**
**Department of Public Works**

# Group A: Project Management

# Quality Assurance Project Plan

For

CWA 319(h)
Grant Agreement No. 12-412-259
San Diego Region

Nutrient Source Reduction Program
in the Rainbow Creek Watershed
Water Quality Monitoring

March 3, 2016
Revision 2

The County of San Diego
Watershed Protection Program
Science and Monitoring Group
Department of Public Works

# Element A1: Approval Sheet

**GRANT ORGANIZATION:**

| Title: | Name: | Signature: | Signature Date:* |
|---|---|---|---|
| Project Director | Todd Snyder | | |
| Grant Contact | Lauren Moreno | | |
| Water Quality Monitoring Program Coordinator | Jo Ann Weber | | |
| QA Officer | Joanna Wisniewska | | |
| Laboratory QA Director | Jennifer Beyer | | |
| Laboratory Director | Dan Verdon | | |

**STATE BOARD:**

| Title: | Name: | Signature: | Signature Date:* |
|---|---|---|---|
| Grant and Contract Manager | Laurie Walsh | | |
| Program Analyst | Michele Stebbins | | |
| QA Officer | Helen Yu | | |

***** *This is a contractual document. The signature dates indicate the earliest date when the project can start.*

# Element A2: Table of Contents

## List of Tables

# List of Figures

# Element A3: Distribution List

Table 1 identifies those individuals who will receive one (1) copy of the approved Quality Assurance Project Plan (QAPP) and any additional updates to the QAPP.

**Table 1: QAPP Distribution List**

| Title: | Name (Affiliation) | Tel. No.: |
|---|---|---|
| Land Use and Environmental Planning Manager, Project Director | Todd Snyder (County of San Diego) | (858) 694-3482 |
| Land Use and Environmental Planner III, Grant Contact | Lauren Moreno (County of San Diego) | (858) 740-8032 |
| Water Quality Monitoring Program Coordinator, Science and Monitoring Group Supervisor | Jo Ann Weber (County of San Diego) | (858) 495-5317 |
| Land Use and Environmental Planner III, QA Officer | Joanna Wisniewska (County of San Diego) | (858) 694-2312 |
| Land Use and Environmental Planner II, Field Staff | Steven DiDonna (County of San Diego) | (858) 694-2332 |
| Land Use and Environmental Planner II, Field Staff | Ken Liddell (County of San Diego) | (858) 495-5293 |
| Laboratory QA Director | Jennifer Beyer (EnviroMatrix Analytical, Inc. Laboratory) | (858) 560-7717 |
| Laboratory Director | Dan Verdon (EnviroMatrix Analytical, Inc. Laboratory) | (858) 560-7717 |
| San Diego RWQCB Grant Manager | Laurie Walsh (RWQCB9) | (858) 637-5586 |
| San Diego RWQCB QA Officer | Helen Yu (RWQCB9) | (808) 627-3964 |
| SWRCB Program Analyst | Michele Stebbins (SWRCB) | (916) 341-5665 |

# Element A4: Project/Task Organization

## Involved Parties and Project Roles

The Science and Monitoring Group is part of the Watershed Protection Program in the County of San Diego's Department of Public Works. This group will be responsible for the maintenance of field sampling equipment, collection of field measurements and analytical samples, submittal of samples to the laboratory for analysis, compiling and storage of the data, data analysis and reporting, and the management of the contract with EnviroMatrix Analytical Inc. Laboratory (EnviroMatrix). See Figure 1 for the organizational chart of the individuals involved in this project.

Todd Snyder is the Project Director who will oversee all activities related to this project. Lauren Moreno is the Grant Contact who will manage the day to day activities of the grant. Jo Ann Weber is the Water Quality Monitoring Program Coordinator and Supervisor of the Science and Monitoring Group. She will be responsible for the overall management of the monitoring plan and QAPP. In addition, she will provide technical advice on the monitoring program, design, data analysis, and reporting.

Steven DiDonna is responsible for the purchasing of sampling equipment and supplies, maintaining the project database and providing GIS support as necessary. As field staff, his responsibilities also include calibration and maintenance of field equipment, collection of field measurements and analytical laboratory samples in accordance with all method and quality assurance requirements in this QAPP, downloading and labeling of photos from each site visit and transcription of data from field datasheets into the project database.

Ken Liddell is responsible for the coordination with EnviroMatrix Analytical Inc. Laboratory for sample pick-up, bottle supplies, invoicing, and all communications regarding the laboratory contract. As field staff, his responsibilities also include calibration and maintenance of field equipment, collection of field measurements and analytical laboratory samples in accordance with all method and quality assurance requirements in this QAPP, downloading and labeling of photos from each site visit and transcription of data from field datasheets into the project database.

The QA officer assigns staff to perform routine quality assurance and quality control (QA/QC) of field equipment as well as preparing laboratory control samples.

EnviroMatrix Analytical Inc. Laboratory is the contract laboratory for all analyses not conducted in the field. EnviroMatrix will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP and their "Quality Assurance Program Manual" (See Appendix 11). EnviroMatrix will also act as a technical resource to the Science and Monitoring Group and the Watershed Protection Program. Dan Verdon is the Laboratory Director and will serve as a Laboratory Coordinator for this project. Jennifer Beyer is the Laboratory QA Director.

All individuals identified above and in Table 2 are responsible parties of the Nutrient Source Reduction Program in the Rainbow Creek Watershed Water Quality Monitoring Project.

**Quality Assurance Officer Role**

Joanna Wisniewska is the Science and Monitoring Group QA Officer who will ensure that data reported by the Science and Monitoring Group for the County of San Diego has been generated in compliance with the Program's Quality Assurance Manual and the appropriate protocols. As QA Officer, she will not be involved in the collection of samples or the generations of project data.

Specific duties of the QA Officer include conducting audits of ongoing tests, data packages, and completed reports, conducting audits of the routine quality control documentation of laboratory procedures, communicating potential quality control problems to staff and the laboratory, and assuring that any problems are resolved. Ms. Wisniewska will work with Dan Verdon (Laboratory Director) and Jennifer Beyer (Laboratory QA Director) to communicate and resolve any quality assurance and quality control issues. Ms. Wisniewska will also review and assess all procedures during the life of the grant contract against QAPP requirements. All findings will be reported to Jo Ann Weber, including all requests for corrective action. Ms. Weber or Ms. Wisniewska may stop all actions, including those conducted by EnviroMatrix if there are significant deviations from required practices or if there is evidence of a systematic failure.

The QA Officer is also responsible for issuing Quality Assurance Reports to Management, maintaining a current Quality Assurance Project Plan, and issuing the QAPP as required.

**Persons Responsible for QAPP Update and Maintenance**

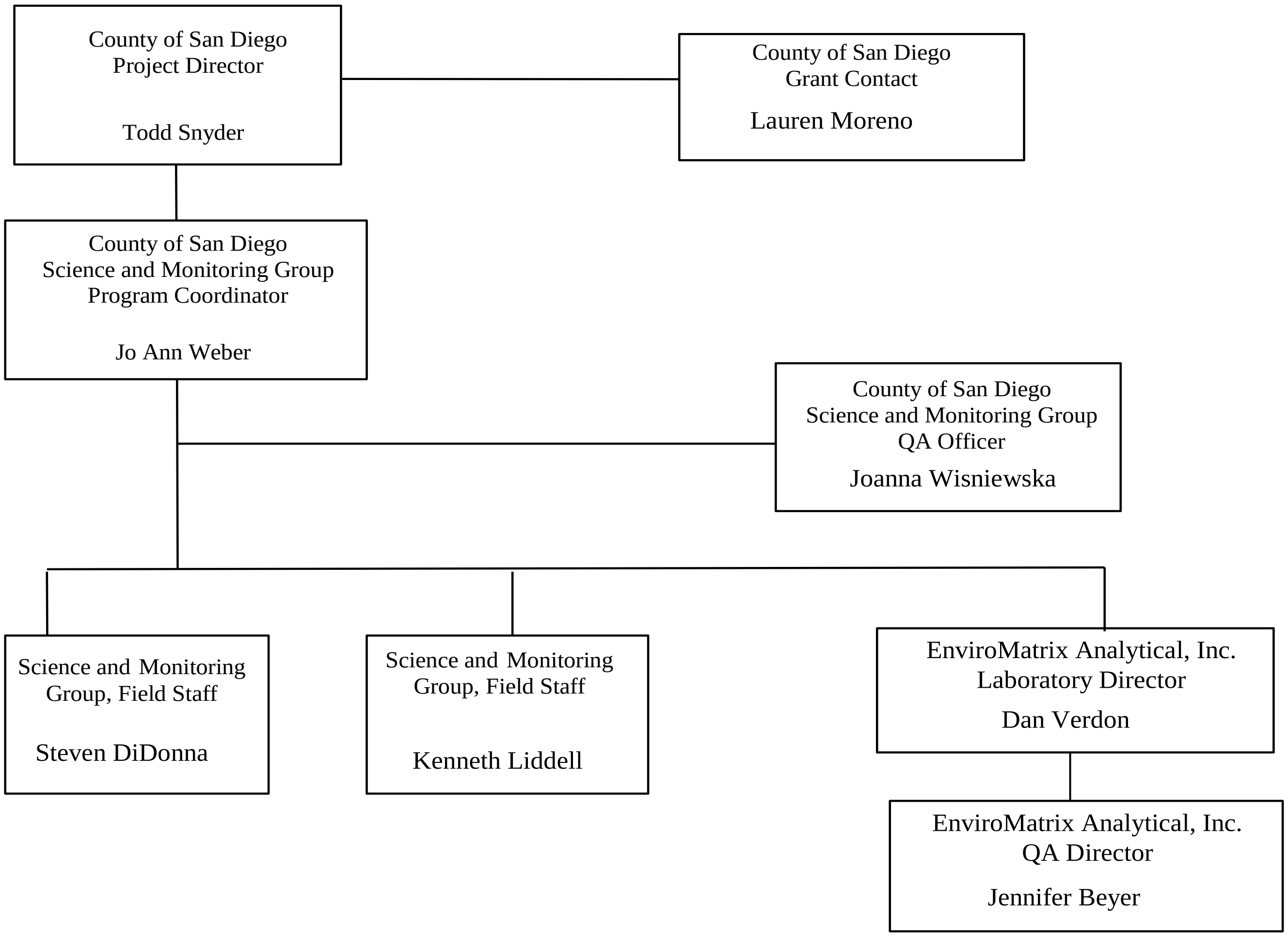
Changes and updates to this QAPP may be made after a review of the evidence for change by the Science and Monitoring Group, Program Coordinator and/or Quality Assurance Officer. Science and Monitoring Group's Quality Assurance Officer will be responsible for making the changes, submitting drafts for review and preparing a final copy.

**Table 2: Personnel Responsibilities**

| Name | Organizational Affiliation | Title | Contact Information (Telephone Number, fax number, e-mail address) |
|---|---|---|---|
| Todd Snyder | County of San Diego, Watershed Protection Program | Project Director | (858) 694-3482<br>(858) 495-5263<br>todd.snyder@sdcounty.ca.gov |
| Jo Ann Weber | County of San Diego, Watershed Protection Program | Program Coordinator, Supervisor | (858) 495-5317<br>(858) 495-5263<br>joann.weber@sdcounty.ca.gov |
| Lauren Moreno | County of San Diego, Watershed Protection Program | Grant Contact | (858) 740-8032<br>lauren.moreno@sdcounty.ca.gov |

| Name | Organizational Affiliation | Title | Contact Information (Telephone Number, fax number, e-mail address) |
|---|---|---|---|
| Steven DiDonna | County of San Diego, Watershed Protection Program | Field Staff | (858) 694-2332<br>(858) 495-5263<br>steven.didonna@sdcounty.ca.gov |
| Ken Liddell | County of San Diego, Watershed Protection Program | Field Staff | (858) 495-5293<br>(858) 495-5263<br>kenneth.liddell@sdcounty.ca.gov |
| Joanna Wisniewska | County of San Diego, Watershed Protection Program | QA Officer | (858) 694-2312<br>(858) 495-5263<br>joanna.wisniewska@sdcounty.ca.gov |
| Dan Verdon | EnviroMatrix Analytical Inc., Laboratory | Laboratory Director | (858) 560-7717<br>dverdon@EnviroMatrixinc.com |
| Jennifer Beyer | EnviroMatrix Analytical Inc., Laboratory | Laboratory QA Director | (858) 560-7717<br>jbeyer@EnviroMatrixinc.com |

**Figure 1: Organizational Chart of Individuals Involved in the Project**



# Element A5: Problem Definition/Background

## Background

In 2005, the San Diego Regional Water Quality Control Board (SDRWQCB) adopted The Rainbow Creek Total Maximum Daily Loads (TMDLs) for Total Nitrogen and Total Phosphorus in the Rainbow Creek Watershed (Resolution R9-2005-0036). On June 27, 2013, the TMDL has been incorporated into the California Regional Water Quality Control Board San Diego Region Order No. R9-2013-0001 NPDES No. CAS0109266 National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4s) Draining the Watersheds within the San Diego Region (MS4 Permit).  The TMDL requires the County, as the agency with land use authority and control over the storm drain system in the watershed, to reduce nutrient inputs to the Creek. Full compliance with TMDL limits in Rainbow Creek is required by 2021. Rainbow Creek is also a key tributary to the Santa Margarita River and Santa Margarita Lagoon, both of which are 303(d) listed as impaired by nutrients.

In 2012, the County of San Diego, in cooperation with Mission Resource Conservation District (MRCD), the University of California Cooperative Extension – Farm and Home Advisor (UCCE), and the California Department of Transportation; applied for and were awarded funding from the Clean Water Act 319(h) Nonpoint Source Pollution Control Program Grant. Grant funds received from the 319(h) grant program will be used to implement the Nutrient Source Reduction Program (NSRP) proposed by the County and its collaborators. Implementation efforts associated with the NSRP will target nutrient reductions within the Rainbow Creek Watershed.

NSRP Implementation activities were strategically selected to target key sources and expand upon existing programs that have proven effective in the past and that emphasize partnerships with organizations that have long-standing track records of success in the watershed. The NSRP will facilitate expansion of these successes to additional properties within Rainbow Creek and provide information needed to assess the next steps of program implementation in the watershed. The County partnership with MRCD and UCCE will take advantage of the technical expertise of both organizations and to build upon existing relationships with residential and agricultural stakeholders in the area.

## Decisions and Outcomes

The overall goal of this project is to assist in implementing a combination of structural, nonstructural and pollution prevention measures that will help restore Rainbow Creek's beneficial uses.

The monitoring program for the implementation of this grant includes receiving water quality monitoring in Rainbow Creek and its tributaries. The results will be used to assist in characterizing baseline conditions, evaluating BMP effectiveness to reduce nutrient loading to creek, and track changes in water quality and the trajectory to attaining the TMDL goals over time.

Water quality monitoring of Rainbow Creek will be conducted once a month at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL.

**Water Quality or Regulatory Criteria**

The data quality objectives (DQOs) for analytical constituents should be set to ensure that, to the maximum extent practicable, the laboratory reporting limits fall below the corresponding regulatory criteria. To meet the DQOs, the analytical quantitation limits are compared to the Water Quality Control Plan (Basin Plan, RWQCB 1994) for the San Diego Region and Title 40 of the Code of Federal Regulations (Part 131; Water Quality Standards) (USEPA 2000a). Table 3 lists the constituents that will be monitored as part of the Rainbow Creek Monitoring Project, their associated water quality criteria, and the applicable analytical quantitation limits for this QAPP. These include *in-situ* measurements of water temperature, specific conductivity, turbidity, pH, and dissolved oxygen. Water samples will also be collected and analyzed for nutrients (ammonia as N, nitrate as N, nitrite as N, total Kjeldahl nitrogen (TKN), orthophosphate as P, total phosphate as P, total iron, sulfate and total dissolved solids (TDS). Although sulfate, total iron and TDS are not nutrients and, therefore, not relevant in demonstrating progress toward achieving compliance with Rainbow Creek TMDL, voluntary monitoring for these constituents is conducted per the 2010 version of *the Sampling and Analysis Plan for Rainbow Creek Nutrient Reduction TMDL Implementation Water Quality Monitoring* (2010 Rainbow Creek TMDL Monitoring Plan).

**Table 3: Water Quality Criteria for the Rainbow Creek Monitoring Project**

| Constituent | Water Quality Criteria | Source | Target Reporting Limit |
|---|---|---|---|
| Ammonia-N | 0.025 (mg/L (unionized)) | Basin Plan (RWQCB 1994) | 0.1 (mg/L)** |
| Dissolved Oxygen | 6.0 (mg/L) | Basin Plan (RWQCB 1994) | 0.2 (mg/L) |
| Iron, Total* | 0.3 (mg/L) | Basin Plan (RWQCB 1994) | 0.1 (mg/L) |
| Nitrate-N | 1.0 (mg/L) | Basin Plan (RWQCB 1994) and Rainbow Creek TMDL | 0.05 (mg/L) |
| Nitrite-N | 1.0 (mg/L) | Basin Plan (RWQCB 1994) | 0.05 (mg/L) |
| Ortho-Phosphate-P | 0.1 (mg/L) | Basin Plan (RWQCB 1994) | 0.05 (mg/L) |
| pH | <6.5 or >8.5 (pH units) | Basin Plan (RWQCB 1994), with allowance for elevated pH due to excessive photosynthesis. Elevated pH is especially problematic in combination with high ammonia. | 0.1 (pH units) |
| Specific Conductivity | N/A | N/A | 2.0 (umhos/cm) |
| Sulfate* | 250 (mg/L) | Basin Plan (RWQCB 1994) | 5.0 (mg/L) |
| Temperature | increase of 5°F above natural water temperature | Basin Plan (RWQCB 1994) | 0.2(°C) |
| Total Dissolved Solids* | 750 (mg/L) | Basin Plan (RWQCB 1994) | 20 (mg/L) |

| Constituent | Water Quality Criteria | Source | Target Reporting Limit |
|---|---|---|---|
| Total Kjeldahl Nitrogen | 1.0 (mg/L) | Basin Plan (RWQCB 1994) | 0.5 (mg/L) |
| Total Phosphate-P | 0.1 (mg/L) | Basin Plan (RWQCB 1994) | 0.05 (mg/L) |
| Turbidity | 20 (NTU) | Basin Plan (RWQCB 1994) | 1 (NTU) |

*Rainbow Creek TMDL does not require monitoring for these constituents. Monitoring for total iron, sulfate and TDS is voluntary and is conducted per the 2010 version of the *Sampling and Analysis Plan for Rainbow Creek Nutrient Reduction TMDL Implementation Water Quality Monitoring* (2010 Rainbow Creek TMDL Monitoring Plan) (MS4 Permit requirement)

** Although the laboratory reporting limit for ammonia is 0.1 mg/L, the laboratory detection limit is 0.02 mg/L with results reported below the laboratory RL and “j” flagged

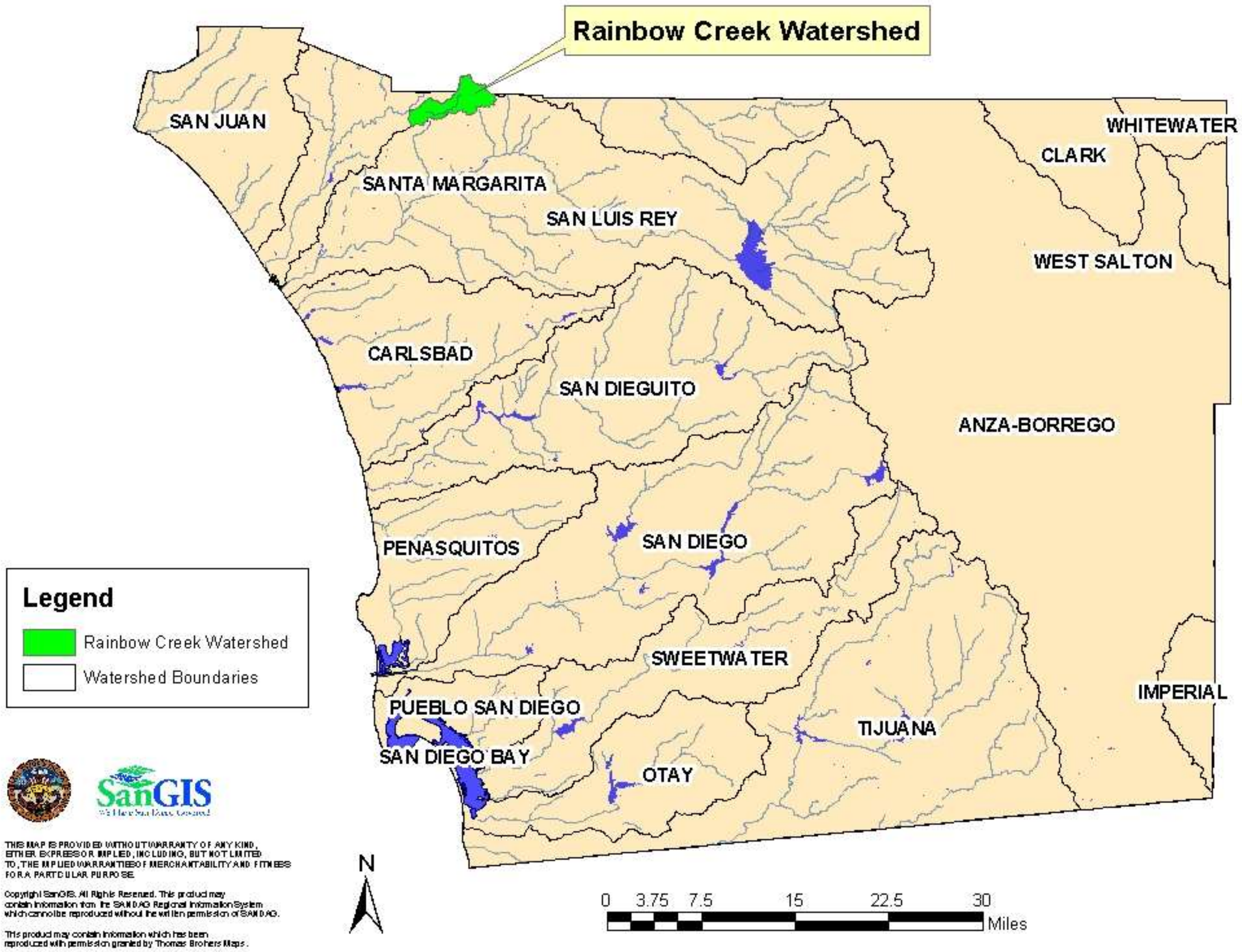



**Figure 2: Location of Rainbow Creek Watershed in San Diego County**

# Element A6: Project/Task Description

## Work Statements and Produced Products

Water quality monitoring will be conducted once a month to characterize pollutant loading and to evaluate the effect of nutrient source reduction efforts. Sampling will be conducted at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. The outcomes of this monitoring program will be an assessment of the current conditions in Rainbow Creek and the impact of nutrient source reduction efforts on receiving water quality.

## Constituents to be Monitored and Measurement Techniques

Water quality monitoring will include field observation, photo documentation, analytical water sample collection, flow measurements, and physicochemical measurements.

Qualitative field observations will be made during each site visit whether or not ponded or flowing water is present. These observations are intended to provide a general assessment of the site and include variables such as odor, water clarity, presence or absence of floatable matter, visible deposits/ stains, vegetative density, and biological status. All field information will be recorded on Rainbow Creek Field Data Sheets (Appendix 1).

Each site will be photographed to provide additional information and documentation of site conditions. In addition to providing important descriptive information, photographs serve as official records of the site visits; visual records of the condition of the pipes, structures and the surrounding environment that can assist other staff in locating sites in subsequent site visits. Flow measurements will be taken at each site where water is flowing. Estimated flow rates can be used to calculate pollutant mass loading, prioritize storm drains for future investigations, or to identify significant changes in flow that may be indicative of an illegal release upstream. Since a majority of sample locations lack a permanent flow measurement installation, flow will be measured using a handheld flow meter. If water flow is too slow or the water is too shallow to measure the velocity using the flow meter the velocity may be estimated by timing the travel of a piece of floating debris (e.g., a leaf). The "apparent" velocity is calculated by dividing the travel distance (feet) by the recorded travel time (second).

Water physicochemical properties will be measured at each site where water is flowing or ponded. The parameters measured will include pH, conductivity, turbidity, dissolved oxygen (DO), and temperature using a Horiba U-50 Series Multi-Parameter Meter. If water is deep enough, the probe will be placed horizontally in the creek, facing upstream. If water is shallow, a syringe will be used to collect water to a plastic beaker, and then measure its properties. Due to the sampling process involved, DO measurements in a beaker may be different from *in situ* measurements. All data will be recorded on the Field Data Sheet.

Water samples collected from target sites with flowing water and will be analyzed in the laboratory. Constituents for the Rainbow Creek Monitoring Program include: ammonia as N, nitrate as N, nitrite as N, total Kjeldahl nitrogen, ortho-phosphate as P, total phosphate as P, total iron, sulfate and total dissolved solids (TDS). The analytical methods used to measure all parameters are presented in Table 4.

**Table 4: Constituents to be Monitored and Corresponding Analytical Methods**

| Field Monitoring | | |
|---|---|---|
| **Constituent** | **Analytical Method** | **Notes** |
| Dissolved Oxygen | Collected in Field | Horiba U-50 Series Multi-Parameter Meter |
| pH | Collected in Field | |
| Specific Conductivity | Collected in Field | |
| Temperature | Collected in Field | |
| Turbidity | Collected in Field | |
| **Laboratory Monitoring** | | |
| **Constituent** | **Analytical Method** | **Notes** |
| Ammonia-N | SM 4500 NH3 B,C | |
| Iron, Total | EPA 200.7 | Optional per 2010 Workplan |
| Nitrate-N | SM 4500 NO3 E | |
| Nitrite-N | SM 4500 NO2 B | |
| Ortho-Phosphate-P | SM 4500 P E | |
| Sulfate | SM 4500 SO4 E | Optional per 2010 Workplan |
| Total Dissolved Solids | SM 2340 C | Optional per 2010 Workplan |
| Total Kjeldahl Nitrogen (TKN) | SM 4500 N C | |
| Total Phosphate-P | SM 4500 P B,E | |

**Project Schedule**

Table 5 details the project schedule for Rainbow Creek Monitoring Project, including start and end dates of major tasks, required deliverables, and their corresponding due dates.

**Table 5: Project Schedule and Deliverables**

| Activity | Date | | Deliverable | Deliverable Due Date |
|---|---|---|---|---|
| | Anticipated Date of Initiation | Anticipated Date of Completion | | |
| Prepare and Submit Monitoring Plan | 6/1/2013 | 8/29/2013 | Monitoring Plan | Completed 7/17/2013 |
| Prepare and Submit Quality Assurance Project Plan | 6/1/2013 | 8/29/2013 | QAPP | Completed 10/23/2013 |
| Determine Stream Reach and Monitoring Locations | 6/1/2013 | 9/29/2013 | List of Monitoring Locations | Completed 7/17/2013 |
| Prepare and Submit Project Assessment and Evaluation Plan (PAEP) | 6/1/2013 | 7/1/2013 | Project Assessment and Evaluation Plan (PAEP) | Completed 7/17/2013 |
| Conduct Water Quality Monitoring | 6/1/2013 | 2/28/2016 | None | |
| Monitoring Reports | 6/1/2013 | Quarterly | Quarterly Monitoring Reports | Quarterly |
| Prepare and Submit Quarterly Progress Reports | 6/1/2013 | Quarterly | Quarterly Progress Reports | by 20th of Apr., Jul., Oct., and Jan. of each year |
| Prepare and Submit Annual Progress Summaries | 6/1/2013 | 9/30/2013, 9/30/2014, 9/30/2015 | Annual Progress Summaries | Completed 9/30/2015 |
| Prepare and Submit Non-Point Source Pollution Reduction Project Follow-Up Survey Form | 6/1/2013 | 12/15/2013, 12/15/2014, 12/15/2015 | Non-Point Source Pollution Reduction Project Follow-Up Survey Form | 12/15/2013, 12/15/2014, 12/15/2015 |
| Format and Submit all Water Quality Data to CEDEN | 6/1/2013 | 6/1/2016 (before final invoice) | Proof of Water Quality Data Submission to CEDEN | 6/1/2016 (before final invoice) |
| Prepare and Submit Draft\Project Report | | 5/1/2016 | Draft Project Report | 5/1/2016 |
| Prepare and Submit Final Project Report | | 6/1/2016 | Final Project Report | 6/1/2016 |
| Final Project Inspection and Certification | | 6/1/2016 (before final invoice) | Final Project Inspection and Certification | 6/1/2016 (before final invoice) |

## Geographical Setting

Rainbow Creek is a small tributary to the Santa Margarita River located in northern San Diego County, near the community of Fallbrook (see Figure 2 above). The Rainbow Creek watershed is designated in the Basin Plan as hydrologic unit subareas (HSAs) 902.22 and 902.23, and encompasses 7,300 acres. Over 80% of the watershed is located within the County of San Diego, while the northernmost 20% lies in Riverside County.

The watershed is primarily rural, with 50% of its land undeveloped. The remaining land uses include agriculture (19%), residential units (25%), and urban (6%) which is largely comprised of transportation and utilities (County of San Diego, 2010).

Rainbow Creek headwaters begin in the hilly and sparsely developed area east of Rainbow Valley. The creek traverses the relatively flat Rainbow Valley Basin, located about 1.5 miles west of the headwaters and then enters another sparsely populated area with hilly terrain. Rainbow Creek eventually flows into the Santa Margarita River, approximately eight miles from the headwaters. Rainbow Creek is an intermittent stream and is considered a gaining stream. The geology of Rainbow Valley Basin is much like a bowl, which has a restricted outlet. This condition limits ground water flowing from the basin (Peterson 1989) and the large quantities of water imported into the Valley are stored in this unconfined ground water aquifer. The high ground water table may have localized mounding from septic fields and agricultural irrigation. Ground water surfaces in the creek in Rainbow Valley. Ground water also surfaces in the lower reaches of the creek beginning approximately 1 mile below I-15. Additionally, several tributaries join the creek in the lower reaches of the watershed.

**Constraints**

Monitoring will not be conducted during any rain event >0.1 inch in precipitation until the water level returns to within approximately 10% of the pre-rain creek level as verified by using USGS flow station data for Rainbow Creek (http://nwis.waterdata.usgs.gov/nwis/nwisman/?site_no=11044250&agency_cd=USGS). If rain is scattered, precipitation will be checked to determine if any occurred within the Rainbow Creek Watershed. If staff is in the field and the weather turns to rain, staff will discontinue sampling and return to DPW headquarters. If weather conditions are suspect, conditions will be verified prior to departure to sampling locations using the following sources:

- Department of Public Works Flood Control Section at (858) 495-5557 (7:00 am - 4:00 pm weekdays).

- National Weather Service weather forecasts 24-hour recorded message at (619) 289-1212 or http://www.wrh.noaa.gov/sgx/

Water quality monitoring of Rainbow Creek will occur at approximately 30-day intervals unless weather conditions prohibit sample collection. Samples will not be collected if water is ponded.

# Element A7: Quality Objectives and Criteria for Measurement Data

Data generated for this project must meet the measurement quality objectives for accuracy, precision, completeness, and recovery (accuracy, precision, and completeness for field testing) as listed in Table 6, Table 7, and Table 8 to be SWAMP compatible. The data must also be representative of the general environment/ conditions being studied.

Any previously collected data must meet the aforementioned criteria to be acceptable into the Rainbow Creek Project.

**Table 6: Summary of Measurement Quality Objectives.**

| Measurement or Analyses Type | Applicable Data Quality Objective |
|---|---|
| **Field Testing** | |
| Conductivity<br>Dissolved Oxygen<br>pH<br>Temperature<br>Turbidity | Accuracy, Precision, Completeness |
| **Chemical Laboratory Analysis** | |
| Ammonia-N<br>Iron, Total<br>Nitrate-N<br>Nitrite-N<br>Ortho-Phosphate-P<br>Sulfate<br>Total Dissolved Solids<br>Total Kjeldahl Nitrogen<br>Total Phosphate-P | Accuracy, Precision, Recovery, Completeness |

**Table 7: Measurement Quality Objectives for Field Data**

| Group | Parameter | Accuracy | Precision | Target Reporting Limits | Completeness |
|---|---|---|---|---|---|
| Field Testing | Dissolved Oxygen | ± 0.2 mg/L | 0.1 mg/L | 0.2 mg/L | 90% |
| | pH | ± 0.2 units | ± 0.05 units | NA | 90% |
| | Specific Conductivity | ± 2 µS/cm | ± 1% | 2 µS/cm | 90% |
| | Temperature | ± 0.1 °C | ± 0.3 °C | NA | 90% |
| | Turbidity | ± 1 NTU | ± 3% | 5 NTU | 90% |

**Table 8: Measurement Quality Objectives for Laboratory Data.**

| Group | Parameter | Accuracy* | Precision* | Completeness* | Laboratory Target Reporting Limits | Project Action Limits |
|---|---|---|---|---|---|---|
| Chemical Laboratory Analysis | Ammonia-N | Method Blank results < RL ; Blind Field Blank results < RL; Reference Material Recovery within 90-110%; Matrix Spike Recovery within 80-120% | Lab Replicate RPD<25%[1]; Matrix Spike Replicate RPD < 25%; Blind Field Duplicate RPD < 25% | 90% | 0.1 (mg/L)** | 0.025 (mg/L) |
| | Nitrate-N | | | | 0.05 (mg/L) | 1.0 (mg/L) |
| | Nitrite-N | | | | 0.05 (mg/L) | 1.0 (mg/L) |
| | Ortho-Phosphate-P | | | | 0.05 (mg/L) | 0.1 (mg/L) |
| | Total Kjeldahl Nitrogen | | | | 0.5 (mg/L) | 1.0 (mg/L) |
| | Total Phosphate-P | | | | 0.05 (mg/L) | 0.1 (mg/L) |
| | | Method Blank results < RL ; Blind Field Blank results < RL; Calibration Verification within 80-120%; Reference Material Recovery within 75-125%; Matrix Spike Recovery within 75-125% | Lab Replicate RPD<25%[1]; Matrix Spike Replicate RPD < 25%; Blind Field Duplicate RPD < 25% | | | |
| | Iron, Total | | | | 0.1 (mg/L) | 0.3 (mg/L) |
| | Sulfate | | | | 5.0 (mg/L) | 250 (mg/L) |
| | Total Dissolved Solids | | | | 20.0 (mg/L) | 750 (mg/L) |

* See the attached EnviroMatrix "Quality Assurance Program Manual" (laboratory's QA/QC manual) for a discussion on Accuracy, Precision, and Completeness in Section 5.2 – "Completeness, Representativeness, and Comparability"

** Although the laboratory reporting limit for ammonia is 0.1 mg/L, the laboratory detection limit is 0.02 mg/L with results reported below the laboratory RL and "j" flagged

[1] Where one or both duplicate sample results are below the Reporting Limit for a given analyte, the result(s) <RL will be assumed to equal RL in the RPD calculations.

To ensure the proper representativeness of the water quality data, sampling will be conducted monthly at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. Sample location RBC01 will represent water quality of the Rainbow Creek headwaters, upstream of Rainbow Valley. All other locations, in Rainbow Creek and its tributaries, will be monitored to assist in characterizing baseline conditions and tracking any changes in water quality and will become the baseline monitoring sites for the Rainbow Creek TMDL.

# Element A8: Special Training Needs/ Certification

## Specialized Training and Certifications

Field Personnel

All field personnel will be trained/refresher trained in proper field sampling and sample handling techniques prior to each sampling season/year by the QA Officer. All field personnel are trained and have experience in the collection, handling/storage, and chain of custody procedures as they relate to sample collection. Health and Safety training is conducted each month at Watershed Protection Program staff meetings with an annual update of the Illness, Injury Prevention Plan (IIPP) for the Science and Monitoring group.

Analytical Laboratory

EnviroMatrix Analytical, Inc. Laboratory is certified by ELAP for the analyses of inorganics, toxic chemical elements, and organics in wastewater (Certificate 2564).

## Training and Certification Documentation

All personnel are responsible for complying with all quality assurance/quality control requirements pertaining to their organizational/technical function. Each technical staff member maintains a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, quality assurance/quality control procedures, and records management.

Field Sampling

Field personnel refresher training conducted by the Quality Assurance Officer will be documented and records kept in the County of San Diego Department of Public Work, Human Resources Office and on file at Project Coordinator’s office.

Analytical Laboratory

EnviroMatrix maintains records of its training. Those records can be obtained if needed from EnviroMatrix through the Quality Assurance Director.

## Training Personnel

The Quality Assurance Officer will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and chain of custody procedures.

# Element A9: Documents and Records

The Science and Monitoring Group will document and track all aspects of water quality monitoring and analytical sample collection process. These include sample event log, generating field datasheets at each site, and chain of custody forms for all analytical samples collected (also see Table 5 for a list of project reports). Chain of custody forms will accompany water samples to the laboratory for analysis. EnviroMatrix will document and track all aspects of sample receipt and storage, analyses and reporting. Copies of the chains of custody will be included in the final report.

Science and Monitoring Group will maintain the *Special Projects* database for data collected in this project. Steven DiDonna will manage this database. Data from the field datasheets generated from this project will be entered into the Special Projects database by field staff and checked by the QA Officer. The database and all related electronic files and reports will be backed-up daily through the County of San Diego network service provider.

All records generated by this project will be stored at the Science and Monitoring Group office for a minimum of 10 years. EnviroMatrix Laboratory records pertinent to this project will be maintained at EnviroMatrix main office. Copies of all records held by EnviroMatrix will be provided to the Science and Monitoring Group both electronically, in specified format, and by hard copy and stored in the project file. All electronic records will be stored on the County's shared drive system and backed up on a daily basis. The minimum retention time for the electronic records will also be 10 years.

Copies of this QAPP will be distributed electronically to all parties involved with the project (see QAPP distribution list in Table 1) and uploaded to FAAST upon final approval by the Grant Manager. Updates to this QAPP will be distributed in like manner, and all previous versions will be discarded from the project file.

Persons responsible for maintaining records for this project are as follows. Ken Liddell will maintain the Special Projects sample collection log and the field datasheet forms. The QA Officer will maintain all records associated with the receipt and analysis of samples analyzed by the laboratory, and all records submitted by EnviroMatrix. Ken Liddell will maintain the laboratory chains of custody forms (copies). Steven DiDonna will maintain the Special Projects database. Jennifer Beyer, Laboratory QA Director, will maintain EnviroMatrix records. Science and Monitoring Group Project Coordinator/Supervisor Jo Ann Weber will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records. Lauren Moreno, Project Contact will oversight of approval and submittal of the QAPP.

# Group B: Data Generation and Acquisition

# Element B1: Sampling Process Design (Experimental Design)

The following information includes excerpts from the *Sampling and Analysis Plan for Rainbow Creek Nutrient Reduction TMDL Implementation Water Quality Monitoring* that details the water quality sampling activities.

## Sample Locations

Water quality monitoring is conducted at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. Table 9 lists all locations to be monitored as part of this project; the locations are illustrated on a map in Figure 3. Sample location RBC01 represents water quality of the Rainbow Creek headwaters, upstream of Rainbow Valley.

**Table 9: Rainbow Creek Sample Locations**

| Sample Site ID | Location | Latitude* | Longitude* |
|---|---|---|---|
| RBC01 | Rainbow Creek @ Eastern edge of Hines Nursery | 33.42042 | -117.13571 |
| RBC02 | Rainbow Creek @ Huffstatler Road | 33.41544 | -117.15199 |
| RBC04 | Rainbow Creek @ Old Highway 395 | 33.41272 | -117.15853 |
| RBC06 | Rainbow Creek @ 2219 Willow Glen Road | 33.40881 | -117.20539 |
| RBC10 | Rainbow Creek @ MWD Crossing | 33.40696 | -117.18344 |
| SMG05 | Rainbow Creek @ Willow Glen Road | 33.40788 | -117.20104 |
| SMG06 | Rainbow Creek @ Stage Coach Lane | 33.41056 | -117.21477 |
| RVT02 | Chica tributary @ 1st Street | 33.42126 | -117.14983 |
| HST01 | Brow Ditch to Rainbow Creek @ Huffstatler Road | 33.41526 | -117.15204 |
| HST02 | Pipe from a nursery along Huffstatler Road (downstream of HST01) | 33.41174 | -117.15196 |
| MGT01 | Margarita Glen Tributary to Rainbow Creek | 33.40847 | -117.19877 |
| RGT01 | Rainbow Glen Tributary to Rainbow Creek | 33.41107 | -117.18569 |
| WGT01 | Willow Glen Tributary @ Willow Glen Road | 33.40784 | -117.20309 |
| VMT01 | Via Milpas Tributary to Rainbow Creek | 33.40957 | -117.21373 |

* NAD83, Decimal degree to the 5th digit

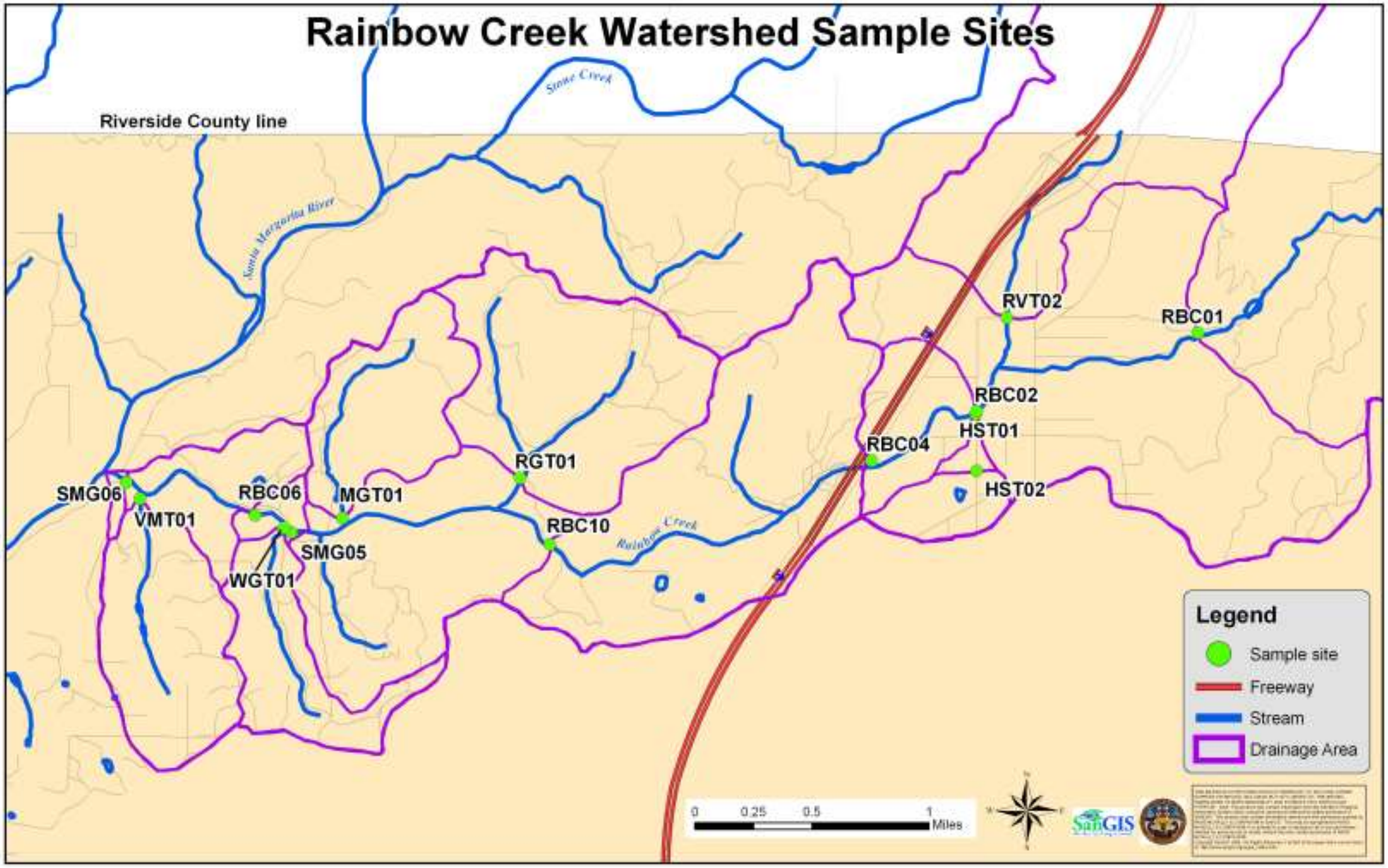



**Figure 3: Rainbow Creek Monitoring Project Sites**

### Sample Frequency

Samples are collected at a minimum once a month at approximately 30-day intervals unless weather conditions prohibit the collection of samples in a safe manner.

Monitoring is not be conducted during any rain event >0.1 inch until the water level returns to within approximately 10% of the pre-rain creek level. If staff is in the field and the weather turns to rain, staff will discontinue sampling and return to DPW headquarters. If weather conditions are suspect, conditions will be verified prior to departure to sampling locations using the following sources:

- Department of Public Works Flood Control Section at (858) 495-5557 (7:00 am - 4:00 pm weekdays).
- National Weather Service weather forecasts 24-hour recorded message at (619) 289-1212 or http://www.wrh.noaa.gov/sgx/

One duplicate sample is collected at a randomly selected site for each sampling event. A field blank is taken once every two sampling events (one for every 24 samples) and sent to the laboratory for analysis.

If sampling sites become inaccessible due to severe weather conditions, samples will be collected no later than 2 working days after severe weather subsides and site(s) become accessible again. If site(s) become permanently inaccessible, new site(s) that most closely resemble the conditions at the inaccessible site(s) will be selected to be available for sampling no later than 2 working days following the planned sample date.

## Element B2: Sampling Methods

Water samples will be collected from the most representative portion of the creek. When collecting a water sample from the creek, field personnel will enter the stream just downstream of the designated sampling point. Samples will be collected at the horizontal and vertical center of the stream/creek or at a location that is most representative of the water quality in the creek. Gloves will be worn while analytical sampling. Samples will be collected by pointing the bottle opening upstream lowering the bottle to mid-depth position and allowing the bottle to fill. Field staff will avoid collecting floating debris. In shallow water conditions (less than 6 inches deep), it will suffice to fill the bottle from the surface of the stream rather than sample at mid-depth. A clean syringe may also be used to collect water in very low flow or ponded water situations.

All sample locations with water will be monitored for the in-situ parameters of pH, temperature, conductivity, turbidity and dissolved oxygen. Field measured results will be recorded on field data sheets (Appendix 1). The maintenance and cleaning procedures of the Horiba U-50 Series Multi-Parameter Meter are described in the “Instrument Inspection and Maintenance” section of the Horiba meter SOP in Appendix 5. The probes will be cleaned with tap water followed by a deionized water rinse. The flow meter will be inspected for debris and rinsed with top water by the end of each sampling day. No special decontamination procedures are needed for the Horiba U-50 Series

Multi-Parameter Meter or the flow meter. The rinsate will be disposed of in the sanitary sewer.

Grab samples will be collected in clean sample bottles provided by the lab and analyzed for the following constituents: ammonia as N, nitrate as N, nitrite as N, total kjeldahl nitrogen (TKN), total phosphate as P, ortho-phosphate as P, total iron, sulfate, and total dissolved solids (TDS),. Table 10 lists the analytical methods, sample volumes, container types, and sample preservation and holding times. EnviroMatrix Analytical, Inc. Laboratory follows standard procedures for cleaning and decontamination of analytical equipment and glass sample containers are described in section in the EnviroMatrix Analytical, Inc. Quality Assurance Program Manual. The coordination and disposal of laboratory hazardous waste procedures are discussed in Section 7.3 of the Manual.

**Table 10: Water Quality Analytical Parameters for Water Quality Monitoring Projects**

| Analytical Parameter | Analytical Method | Container Type | Sample Volume (mL) | Preservative* | Maximum Holding Time |
|---|---|---|---|---|---|
| Dissolved Oxygen | N/A | Analyzed in Field | N/A | N/A | N/A |
| pH | N/A | Analyzed in Field | N/A | N/A | N/A |
| Specific Conductivity | N/A | Analyzed in Field | N/A | N/A | N/A |
| Temperature | N/A | Analyzed in Field | N/A | N/A | N/A |
| Turbidity | N/A | Analyzed in Field | N/A | N/A | N/A |
| Ammonia-N | SM 4500 NH3 B,C | Plastic | 250 | Acidify to pH<2 with H2SO4 | 28 days |
| Iron, Total** | EPA 200.7 | Plastic | 250 | Acidify to pH<2 with HNO3 | 6 months |
| Nitrate-N | SM 4500 NO3 E | Plastic | 250 | None | 48 hours |
| Nitrite-N | SM 4500 NO2 B | Plastic | 250 | None | 48 hours |
| Ortho-Phosphate-P | SM 4500 P E | Plastic | 250 | None | 48 hours |
| Sulfate** | SM 4500 SO4 E | Plastic | 250 | None | 28 days |
| Total Dissolved Solids** | SM 2540 C | Plastic | 1,000 | None | 7 days |
| Total Kjeldahl Nitrogen | SM 4500 N C | Plastic | 1,000 | H2SO4 | 28 days |
| Total Phosphate-P | SM 4500 P B, E | Plastic | 250 | H2SO4 | 28 days |

* All samples will be kept on ice at ≤4°C in a cooler after collection.

**Rainbow Creek TMDL does not require monitoring for these constituents. Monitoring for total iron, sulfate and TDS is voluntary and is conducted per the 2010 Rainbow Creek TMDL Monitoring Plan

<u>Corrective Actions for Field Activities</u>

If monitoring equipment fails, field personnel will report the problem in the comment section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment prior to the next field use. No data will be entered into the electronic database that is known to be collected with any faulty equipment.

# Element B3: Sample Handling and Custody

### Photo Documentation

No special handling or custody procedures are needed. The digital camera is returned to the office and the photographs are downloaded and labeled and placed in their appropriate folders.

### Water Quality Samples

The grab samples collected during monitoring events will be labeled with site locations, dates, sample times, analysis to be performed, sample preservation (if any) and field sampler's name. All information related to sample locations will be recorded on a Field Data Sheets (Appendix 1). A sample event ID log book will be used to record each site visit with a unique sample event ID number. The time, date, site, and event type will be recorded next to the "Sample Event ID" in the log book. Sample bottles will be stored and transported on ice, maintaining ≤ 4 degrees Celsius ($^{o}$C) until processed. Samples will be delivered to EnviroMatrix Analytical Inc. and analysis initiated within holding times specified in Table 10. A Chain of Custody (COC) form will accompany samples throughout the process.

### Chain of Custody Procedures

The Chain of Custody (COC) forms and field data sheets will be the principal documents used to identify samples and to document possession. Chain of custody forms will be used to transfer the samples from field collection staff to laboratory staff.

COC procedures will be initiated during sample collection. A COC form will accompany each group of samples. Each person who will have custody of the samples will sign the form and ensure the samples are not left unattended unless properly secured. Documentation of sampling handling and custody includes the following:

- Sampler identifier
- Sample collection date and time
- Sample Event ID number
- Any special notations on sample characteristics
- Signature of person(s) collecting the sample
- Date and time the sample was picked up by EnviroMatrix staff
- Constituents to be tested, preservatives, and temperature requirements

Field staff will assure that the COC forms are kept dry and legible. At the laboratory, field staff will check that all samples delivered are listed on the COC form and that all necessary information is entered. During sample receipt, the laboratory will verify and document the sample condition and temperature and that the sample labels on the bottle agree with those in the chain of custody form. Any discrepancies will be noted and discussed with the sample delivery personnel or by calling the Program QA Officer. The laboratory staff with then sign the COC, and give a copy to the field staff while keeping the original form. This COC copy will be kept in a notebook in the office by the QA Officer.

EnviroMatrix will store the samples in accordance with the laboratory's QA Program Manual's Section 6.0 – "Sample Custody." COC records will be included in the final reports prepared by EnviroMatrix and are considered integral parts of the reports.

# Element B4: Field Measurements and Analytical Methods

Field Methods

Water physicochemical properties *in situ* will be measured at each site where water is flowing or ponded. The parameters measured will be pH, conductivity, turbidity, dissolved oxygen (DO), and temperature using a Horiba U-50 Series Multi-Parameter Meter. The following field instruments will be employed for the Rainbow Creek project: Horiba U-50 Series Multi-Parameter Meter Water Quality Instrument and a handheld flow meter (Global Water FP-101 handheld flow meter, Global Water FP-201 handheld flow meter). SOPs for each instrument are included in Appendices 5 and 6 which describe calibration, proper use, and what to do if an instrument becomes "fouled". Table 11 details the measurement principal and measurement limits for parameters measured in the field for water quality monitoring.

**Table 11: Field Measurements**

| Constituent | Project Action Limit | Instrument | Measurement Principle | Achievable Field Limits | |
|---|---|---|---|---|---|
| | | | | Resolution | Repeatability |
| Dissolved Oxygen | 6.0 (mg/L) | Horiba U-50 | Membrane/ galvanic cell | 0.01 (mg/L) | ± 0.1 (mg/L) |
| Flow | ----- | Global Water FP-101 | Propeller / electro-magnetic pickup | 0.1 (ft/sec.) | 0.1 (ft/sec.) |
| Flow | ----- | Global Water FP201 | | | |
| pH | <6.5 or >9.0 | Horiba U-50 | Glass electrode | 0.01 (pH units) | 0.05 (pH units) |
| Specific Conductivity | ----- | Horiba U-50 | Alternating four-electrode | 0.001 (mS/cm) | ± 0.05% of full scale |
| Temperature | ----- | Horiba U-50 | Thermistor | 0.01 (°C) | ± 0.10 (°C) |
| Turbidity | 20 (NTU) | Horiba U-50 | Scattering/ transmitting light | 0.1 NTU | ± 0.5 NTU |

Analytical Methods

The attached laboratory's QA Program Manual (Appendix 11) discusses operational procedures, quality assurance, audits, facilities and equipment and other laboratory procedures and policies. The laboratory's QA Program Manual also discusses method performance criteria in Section 17.1. A list of laboratory instruments and equipment needed for laboratory analysis is included in the attached laboratory's QA Program Manual Appendix F.

If laboratory quality control limits are exceeded (i.e. process is out-of-control or failure), corrective action(s) shall be taken and documented (see laboratory's QA Program Manual Section 20; Appendix D of the manual contains the Laboratory Corrective Action Form), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

Sample will be re-analyzed if possible. If the out-of-control process, failure, or out of calibration conditions affected project data results, notification from the Laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

Laboratory sample disposal procedures are outlined in the laboratory's QA Program Manual Section 7.3 – "Sample and Waste Disposal." Laboratory analysis turnaround times are specified as "normal", which are standard industry acceptable times depending on parameter analyzed. Expedited sample analysis may be request with a surcharge. Table 12 lists the standard analytical methods for each constituents analyzed by EnviroMatrix. EnviroMatrix will be the sole laboratory to analyze all constituents listed below.

**Table 12: Laboratory Analytical Methods**

| Analyte | Project Action Limit | Project Quantitation Limit | Analytical Methods | | Achievable Laboratory Limits | |
|---|---|---|---|---|---|---|
| | | | Analytical Method | Modified for Method (Y/N) | Method Detection Limits[1] | Laboratory Reporting Limits[2] |
| Ammonia-N | 0.25 (mg/L unionized) | 0.02 (mg/L) | SM 4500 NH3 B,C | N | 0.02 (mg/L) | 0.1 (mg/L) |
| Iron, Total | 0.3 (mg/L) | 0.02 (mg/L) | EPA 200.7 | N | 0.05 (mg/L) | 0.1 (mg/L) |
| Nitrate-N | 1.0 (mg/L) | 0.01 (mg/L) | SM 4500 NO3 E | N | 0.009 (mg/L) | 0.05 (mg/L) |
| Nitrite-N | 1.0 (mg/L) | 0.01 (mg/L) | SM 4500 NO2 B | N | 0.007 (mg/L) | 0.05 (mg/L) |
| Ortho-Phosphate-P | 0.1 (mg/L) | 0.01 (mg/L) | SM 4500 P E | N | 0.007 (mg/L) | 0.05 (mg/L) |
| Sulfate | 250 (mg/L) | 1.0 (mg/L) | SM 4500 SO4 E | N | 1 (mg/L) | 5 (mg/L) |
| Total Dissolved Solids | 750 (mg/L) | 10 (mg/L) | SM 2340 C | N | 1 (mg/L) | 20 (mg/L) |
| Total Kjeldahl Nitrogen | 1.0 (mg/L) | 0.50 (mg/L) | SM 4500 N C | N | 0.3 (mg/L) | 0.5 (mg/L) |
| Total Phosphate-P | 0.1 (mg/L) | 0.05 (mg/L) | SM 4500 P B,E | N | 0.02 (mg/L) | 0.05 (mg/L) |

[1] Method detection limits are subject to change.
[2] Laboratory detection limits are subject to change.

# Element B5: Quality Control

### Field Measurements

Field measurements of water quality for pH, conductivity and temperature will be made using a Horiba U-50 Series Multi-Parameter Meter according to manufacturer's specifications. Calibration will be conducted prior to each sampling event. Duplicate readings will be made in the field. Proper equipment storage and maintenance procedures will be followed.

### Analytical Chemistry Analyses

Quality control (QC) checks for laboratory will be used to ensure that valid data are collected. Quality assurance and quality control for sampling processes begins with proper collection of the samples in order to minimize the possibility of contamination. All water samples are collected in laboratory provided sample containers.

Blind field blank samples will be collected at a rate of one (1) sample per twenty four (24) (once every other sampling event) and submitted to the laboratory to be analyzed for all constituents listed in Table 12. Blind field blanks are prepared and analyzed to ensure that no sample contamination occurred during collection, transport or storage of environmental samples. They will be prepared in the field using analyte-free water (i.e. reagent-grade water obtained from the laboratory) that is poured into the sample collection device and sub-sampled for chemistry analyses, then handled, transported and delivered to the laboratory in manner identical to the remaining water quality samples. The laboratory personnel would not be notified as to the identity of the samples (will not know whether the samples are blanks or environmental water quality samples). The results of blind field blank analysis will be reported as part of the Data Quality Control and Quality Assurance yearly report.

Blind field duplicate samples will be collected for each Rainbow Creek sampling event at a rate of approximately one (1) sample per twelve (12) and submitted to the laboratory to be analyzed for all constituents listed in Table 12. The blind field duplicates are two samples collected at the same time and location using two sampling bottles, and processed and analyzed in an identical manner.

The chemistry analysis of samples in the laboratory will be performed under the guidelines of the quality assurance and quality control program established by EnviroMatrix (see laboratory's QA Program Manual Section 13 – "Analytical Quality Control." This includes preparation and processing of laboratory blank samples, laboratory duplicates, laboratory control samples (LCS), laboratory control sample duplicates (LCS Dup), matrix spikes, and matrix spike duplicate samples, per analytical batch of 20 or fewer. Duplicate analyses will be prepared by taking two aliquots of sample from the same sample container. The relative percent difference of these two analyses is used to define the precision of the measured result. A matrix spike is a sample prepared by adding a known mass of a target analyte to a specified amount of sample matrix for which an independent estimate of the target analyte concentration is available. Matrix spikes are used to evaluate any bias to the analysis from the sample matrix. A LCS is prepared from a certified standard that is spiked into purified water and analyzed in the same way as with environmental samples. The LCS is used to demonstrate method proficiency irrespective of matrix. The procedures and formulas for calculating precision and accuracy can be found in the laboratory's QA Program Manual Sections 5.0 and 19.

If laboratory quality control limits are exceeded (i.e. process is out-of-control or out of calibration conditions), corrective action(s) shall be taken and documented (see laboratory's QA Program Manual Section 20 and Appendix D), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

Sample will be re-analyzed if possible. If the out-of-control process or out of calibration conditions affected project data results, notification from the Laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

The data quality indicators for laboratory and field measurements will be calculated as follows:

Precision will be calculated as the relative standard deviation (% RSD):

$$\%RSD = \frac{s}{\overline{X}} \times 100$$

Where s is the standard deviation and $\overline{X}$ is the mean of repeated samples.

Accuracy and recovery will be expressed as percent recovery (% R).

$$\%R = \frac{\text{Measured value}}{\text{Known value}} \times 100$$

The measured value may be the mean of several replicate analyses of a spiked sample/standard.

Completeness will be expressed as percent completeness (%C) for measurement parameters:

$$\%C = V/T \times 100$$

Where V is the number of measurements judged valid and *T* is the planned number of measurements.

# Element B6: Instrument/Equipment Testing, Inspection and Maintenance

### Field Measurements

All equipment used in this project will be cleaned and inspected upon return from each sample day/event. The Horiba U-50 Series Multi-Parameter Meter probes will be replaced at the first sign of deviation from standard solution concentrations and noted in the instrument logbook. The Horiba meter will be checked by field staff for calibration before and after each use which will be documented in the instrument logbook. All field staff will be responsible to ensure that the Horiba meter has been calibrated properly before each use. Quarterly, a full calibration of the Horiba meter will be conducted by staff to insure the instrument meets manufacture's specifications and will be documented in the instrument logbook (see Appendix 5, Horiba U-50 Series Multi-Parameter Meter SOP). If calibration results are not within the manufacture's specifications, sensors will be replaced with new parts. Spare parts will be stored in a secure location in the office or will be readily available through the County's vendor.

The handheld flow meter will be checked before each measurement to ensure that propeller is free of debris and moves freely (see Appendix 6, Flow Meter SOP). The digital camera will have fresh spare batteries available vehicle (see Appendix 7, Photo Documentation SOP). No other field equipment for this project requires maintenance.

### Analytical Laboratory

EnviroMatrix Analytical Inc. maintains its equipment in accordance with its standard operating procedures (SOPs), which include those specified by the manufacturer and those specified by the method. EnviroMatrix Laboratory's QA Program Manual details their equipment and systems testing, inspection, maintenance, and calibration specifications and schedule in Section 10 – "Calibration Procedures." If deficiencies are encountered, the laboratory's QA Program Manual Section 20 – "Corrective Action" details how their corrective actions are to be conducted.

# Element B7: Instrument/Equipment Calibration and Frequency

All equipment and instruments used by the Science and Monitoring Group are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs (see Appendix for individual SOPs). Operation and calibration are performed by field staff personnel trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate logbooks. If a critical measurement is found to be out-of-compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis repeated if possible.

### Field Equipment

The Horiba U-50 Series Multi-Parameter Meter used for field *in-situ* measurements will be calibrated prior to use each day using an Autocal calibration procedure. The meter will then be tested using pH 7 and pH 10 solutions to verify that the meter is meeting the DQOs.

Upon return to the lab from the field (post deployment), the instrument will again be checked using the pH 7 and pH 10 standard solutions and the results recorded on the calibration data sheet in the instrument logbook. If measured results do not meet the DQOs, the multi-meter will be recalibrated using the two-point calibrations methods. Calibration frequency for pH, dissolved oxygen, conductivity, and turbidity is approximately every three (3) months (see Appendix 4 for the Horiba meter daily calibration data sheet and Appendix 5 for the Horiba U-50 Series Multi-Parameter Meter SOP).

**Analytical Laboratory**

EnviroMatrix Analytical Inc. calibrates its instruments at a frequency that ensures validity of the results. EnviroMatrix calibration procedures follow USEPA guidelines and the recommendations of the instruments manufacturers. The EnviroMatrix QA Program Manual details their equipment and systems testing, inspection, maintenance, and calibration specifications and schedule in Section 10. If deficiencies are encountered, the laboratory's QA Program Manual Section 20 and Appendix D detail how their corrective actions are to be conducted.

# Element B8: Inspection/Acceptance of Supplies and Consumables

The County of San Diego only purchases supplies and consumables for approved vendors that meet the County of San Diego's Purchasing and Contracting Departments strict guidelines. Critical supplies for this project include sensor parts, calibration standard solutions, buffer solutions, and reagents and will be maintained by Steve DiDonna.

Upon receipt, sensor parts, buffer solutions, standards, and reagents used in the County office laboratory or field will be inspected for leaks, broken seals, or damage. Reagents are replaced before they exceed manufacturer's recommended shelf life. These shelf lives are typically one to two years. However, specific replacement dates can be determined by providing the reagent lot number to the manufacturer. Reagent replacement dates are noted in the reagent log sheet. Field staff will be responsible for keeping the reagent log sheet and ensure that buffer solutions, standards, and reagents used in the laboratory or field will be inspected for leaks or broken seals and replacing if necessary, and also that consumables are replaced before they exceed manufacturer's recommended shelf life. These supplies and consumables are stored on-site in a secure location and are stored in accordance with manufacture's specifications.

All sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation of the sensors on a regular basis.

EnviroMatrix procedures for inspection/acceptance of supplies and consumables are detailed in their QA Program Manual's in Section 8.

# Element B9: Non-Direct Measurements

Non-direct measures will be used to support the selection of sampling sites and to assist in the interpretation of trends in water quality data collected. These measures include data collected during previous years as part of the County of San Diego's Rainbow Creek TMDL Monitoring Program, the County of San Diego Dry Weather Monitoring Program, other special projects, RWQCB SWAMP data, and data obtained from other agencies. In addition, photo documentation, topographical maps, land use maps, and hydrological maps generated from SANDAG and County of San Diego GIS databases, may be used. Any non-direct data used in this project must meet the criteria as stated in Element A7 for measurement quality objectives.

# Element B10: Data Management

Data will be maintained and stored as established in Element A9. All original field data sheets, statistical worksheets, and reports produced will be accumulated into project specific files that are maintained at the Science and Monitoring Group office. Data files, databases and final report text and tables are maintained on the County of San Diego network in a project specific folder and are backed up daily for storage offsite.

### Photo Documentation

Photo files will be named using site and date identifiers.

### Water Quality Samples

Field data sheets are entered into the Science and Monitoring group's Special Project database by field staff according to the Database Entry SOP (Appendix 10). Once the field sheets are entered, the data sheets are dated and initialed by field staff. The QA officer will review the field sheets for completeness and accuracy after input into the Special Project database.

Following initial data entry the QA officer will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that measurement quality objectives have been met, data analysis can be performed.

EnviroMatrix Analytical Inc. records pertinent to this project will be maintained at EnviroMatrix main office. Copies of all records held by EnviroMatrix will be provided to the Science and Monitoring Group both electronically, as EDDs in specified format, and as pdf files and stored in the project file and in a computer folder on the County of San Diego's network. The QA officer will review laboratory EDD data and compare to the pdf reports to confirm that the proper parameters were analyzed and that there are no errors. After performing data checks, and ensuring that measurement quality objectives have been met, data analysis can be performed. All analytical data will be structured to be compatible with the format required for their submittal to the California Environmental Data Exchange Network (CEDEN) as specified in the CEDEN Data Submission Guidelines (www.ceden.org) and they will be uploaded into CEDEN using those guidelines. Microsoft

Office Access 2010 will be used for data entry, storage and retrieval. Data will be further processed, summarized and illustrated using Microsoft Office Excel 2010. Data analysis will be performed using Microsoft Office Excel 2010 and SPSS statistical software package.

# Group C: Assessment and Oversight

# Element C1: Assessment and Response Actions

The commitment to using approved equipment and approved methods when collecting water samples and when conducting field measurements and/or laboratory analyses must have periodic verification that sampling and measurement methods are, in fact, being employed as planned. The internal and/or external verification is required to ensure that:

- All elements of the QAPP are correctly implemented as prescribed.
- The quality of data generated by implementation of the QAPP is adequate.
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

Although external assessments including a 3rd party audit may be employed when needed, internal assessments will provide sufficient information about the degree of implementing the QAPP. All assessment reviews will be made by the Science and Monitoring Group QA Officer. Reviews of field activity will be performed every three months. The assessment information will be reported to the Jo Ann Weber, the Project Manager. Reviews will include, but will not be limited to, the examination of equipment, record keeping, sampling procedures, sample handling and transportation, and field documentation (SOPs).

For EnviroMatrix, system and performance audits are conducted as systematic onsite qualitative assessments. The audits include, but are not limited to, the examination of facilities, equipment, personnel, training, procedures (SOPs), and record keeping for conformance to their QA Program Manual.

Assessments will be carried out by conducting performance evaluation and technical systems audits of field sampling, field measurements, and laboratory analysis. “Blind” samples will be used for performance evaluation. “Blind” samples are those whose identity is unknown to those operating the measurement system. These can be standards, blank or duplicate samples. Use of these materials will allow for assessment of measurement quality objectives such as precision and accuracy.

The QA Officer has the power to halt all sampling and analytical work conducted by both the Science and Monitoring Group and the analytical laboratory if noted deviation(s) are detrimental to data quality.

### Corrective Action Plans

An out-of-control event is defined as any occurrence failing to meet pre-established criteria. A nonconformance is a deficiency in characteristic, documentation, or procedure sufficient to make the quality indeterminate or unacceptable. An out-of-control event is a subcategory of nonconformance.

When either situation is identified, it will be categorized as:

> **Deficiency:** Recognition of a specific requirement (e.g., program, process, or procedure) that has been violated.

**Observation:** Recognition of an activity or action that might be improved but is not in violation of a specific requirement. Left alone, the activity or action may develop into a deficiency.

### Criteria Used for Determination of an Out-of-Control Event

Factors that affect data quality (failure to meet calibration criteria, inadequate recordkeeping, improper storage or preservation of samples) require investigation and corrective action. When a nonconformance is recognized, each individual involved with the analysis in question has an interactive role and responsibility. These are as follows:

• **Technician:** He/She must be able to recognize nonconformances and immediately notify the Laboratory Manager and work with the Quality Assurance Officer to solve the problem. Each technician is responsible for documenting and correcting problems that might affect quality.

• **Laboratory Manager:** He/She must review all analytical and QC data for reasonableness, accuracy, and clerical errors. In an out-of-control event, the Laboratory Manager works with the analyst and Quality Assurance Officer to solve the problem and prevents the reporting of suspect data by stopping work on the analysis in question and insuring that all results that are suspect are repeated, if possible, after the source of the error is determined and remedied. Clients are notified in writing when their samples are affected by an out-of-control event or results of an internal audit. In the event that a QC measure is out-of-control and the data are to be reported, qualifiers are reported together with sample results.

• **Quality Assurance Officer:** In the event that an out-of-control situation occurs that is unnoticed at the bench or supervisory level, the Quality Assurance Officer will notify the Laboratory Manager; help identify and solve the problem where applicable; ensure the work is stopped on the analysis; and verify that no suspect data are reported. The Quality Assurance Officer must review and approve all corrective action reports and submit them to the Laboratory Manager for review.
The Quality Assurance Officer is responsible for reviewing nonconformance report forms, recommending or approving proposed corrective actions, maintaining an up-to-date nonconformance log, and verifying that corrective actions have been completed.

### Procedures for Stopping Analysis

Whenever the analytical system is out-of-control, investigation and correction efforts are initiated by all concerned personnel as outlined in Table 15. If the problem is instrumental or specific only to preparation of a sample batch, samples are reprocessed after the instrument is repaired and recalibrated.

### Laboratory Corrective Action

If an audit discovers any discrepancy, the Science and Monitoring Group QA Officer will discuss the observed discrepancy with the appropriate person responsible for the activity (see organization chart). The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the deviation, how the deviation might impact data quality, and what corrective actions might be considered.

Any findings of practice or procedure that do not conform to the written QAPP must be addressed in a timely manner. Any inadequacy will be documented and notified in a response letter to the laboratory Director. The laboratory Director is then responsible for making any corrections needed and to report in writing these corrective actions to the Science and Monitoring Group QA officer. Copies of the documentation are filed in the project binder. Follow-up inspections may be used to confirm that deficiencies have been addressed and corrected.

If an internal laboratory process is out-of-control or other problem, corrective action(s) shall be taken and documented (see laboratory's QA Program Manual Section 20 – "Corrective Action" and Appendix D), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

If the out-of-control process or out of calibration conditions affected project data results, notification from the laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

**Field Corrective Action**

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The QA Officer is responsible for verifying that all QC procedures are followed. This requires that the QA Officer assess the correctness of the field methods and the ability to meet QA objectives and make a value judgment regarding the impact a procedure has upon the field objects and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or impact data quality, the field staff will immediately notify the QA Officer or the Project Manager. Corrective action measures are then decided upon and implemented. The QA Officer documents the situation, the field objective affected, the corrective action taken, and the results of the action. Copies of the documentation are filed in the project binder.

# Element C2: Reports to Management

Following each year of monitoring, a Quality Assurance Report will be prepared by the County of San Diego Science and Monitoring Group's Quality Assurance Officer. This report will provide updates on program documents, assessments, corrective actions, and quality control, as well as proposed activities for the upcoming year. It will be submitted to the Project Director and the RWQCB Grant Manager. Quality Assurance Reports will be electronically archived by the QA Officer for a minimum of five years. In addition to these reports, documents listed in table 13 will also be prepared and submitted to the County Project Director and RWQCB Grant Manager.

**Table 13: Reports to Management**

| Type of Report | Frequency (daily, weekly, monthly, quarterly, annually, etc.) | Projected Delivery Dates(s) | Person(s) Responsible for Report Preparation | Report Recipients |
|---|---|---|---|---|
| Monitoring Plan | One Time | Completed 7/17/2013 | Lauren Moreno and Joanna Wisniewska | Todd Snyder, Project Director County of San Diego<br><br>And<br><br>Laurie Walsh Grant Manager, RWQCB |
| QAPP | One Time | Completed 10/23/2013 | Lauren Moreno and Joanna Wisniewska | |
| List of Monitoring Locations | One Time | Completed 7/17/2013 | Lauren Moreno | |
| Project Assessment and Evaluation Plan (PAEP) | One Time | Completed 7/17/2013 | Lauren Moreno | |
| Quarterly Monitoring Reports | Quarterly | Varies | Joanna Wisniewska | |
| Quarterly Progress Reports | Quarterly | by 20th of Apr., Jul., Oct., and Jan. of each year | Lauren Moreno | |
| Annual Progress Summaries | Annually | 9/30/2013, 9/30/2014, 9/30/2015 | Lauren Moreno | |
| Nonpoint Source Pollution Reduction Project Follow-Up Survey Form | Annually | 12/15/2013, 2/15/2014, 12/15/2015 | Lauren Moreno | |
| Proof of Water Quality Data Submission to CEDEN | One Time | 6/1/2016 (before final invoice) | Lauren Moreno | |
| Draft Project Report | Annually | 5/1/2016 | Lauren Moreno | |
| Final Project Report | Annually | 6/1/2016 | Lauren Moreno | |

In addition the yearly QA Reports and documents listed in Table 13, a Corrective Action File will be maintained by the QA Officer. When corrective action is required, the party reporting the corrective action will complete a standardized form. Upon review of this form, the QA Officer may revise proposed corrective actions as appropriate. Once the corrective action is approved by the QA Officer, it will be reported to the County of San Diego Program Coordinator and, upon her approval, to any affected parties as appropriate. A copy of each corrective action will be kept on file for at least two years and an electronic logbook of all completed corrective action forms will be maintained by the QA Officer. The resulting file will be reviewed at least annually, and will be archived by the QA Officer for a minimum of five years. Corrective actions will be included in the scope of each annual Quality Assurance Report.

# Group D: Data Validation and Usability

# Element D1: Data Review, Verification and Validation

Data validation is the process whereby data are filtered and accepted or rejected, based on a set of criteria. It is a systematic procedure of reviewing a body of data against a set of criteria to provide assurance of its validity prior to its intended use. All data are checked for accuracy and completeness. The data validation process consists of data generation, reduction, and review (see "Measurement quality objectives and Criteria for Measurement Data" for required criteria to accept project data as SWAMP and CEDEN compatible and "Verification and Validation Methods").

Data reduction, validation, and reporting are on-going processes which involve the technicians, Laboratory Managers, and QA personnel. The Science and Monitoring Group QA Officer will be responsible for the data review, verification, and validation.

EnviroMatrix internal data reduction and validation is describes in detailed in the laboratory's QA Program Manual Section 15 – "Data Reduction, Validation and Reporting."

# Element D2: Verification and Validation Methods

### Database Generation

After each site visit, the field data sheets are checked for completeness and accuracy by the QA Officer. Field data sheets are placed into the Rainbow Creek binder and are labeled with the sampling date.

The data for all field analyses are entered directly onto data sheets. All data sheets are completed in waterproof ink and initialed by the technician, who is responsible for scanning the sheet to be sure it is complete and accurate.

The technician who generates the data has the prime responsibility for the accuracy and completeness of the data. Each technician reviews the data to ensure that:

- Sample description information is correct and complete
- Analysis information is correct and complete
- Results are correct and complete
- Documentation is complete

Data sheets are entered into the Special Projects database by field staff with oversight of the QA Officer (see Appendix 11 for Database Entry SOP). Once the datasheet is entered, the technician will date and initial the top of the datasheet. The datasheet(s) will then be placed in the appropriate project binder in a logical order.

### Error Checking and Verification

All field data entries will be screened by the QA Officer or designee. If any transcription errors (from field data sheets to the database) are found, they will be corrected in the database and/or on the original datasheet. If no errors are found, the datasheet will marked with a "√" and dated and initialed.

Laboratory data validation is accomplished through routine audits of the data collection procedures and by monitoring of QC sample results. Data subject to validation includes dated and signed entries by the technicians and Laboratory Director on the bench sheets and notebooks used for all samples; the use of sample tracking and numbering systems to track the progress of samples through the laboratory; and the use of quality control criteria to reject or accept specific data.

Laboratory data validation is performed by the Laboratory QA Director and is reviewed by the Science and Monitoring QA Officer. If an outlier or other question arises with the data, the QA Officer will contact the Laboratory QA Director and the issue will be addressed and resolved.

The minimum requirements for each analytical run area:

- Matrix spike and duplicate analyses per concentration level and per matrix for every sample batch analyzed (where appropriate).
- Reference materials analyses are compared with "true" values and acceptable ranges. Values outside the acceptable ranges indicate that the sample values are invalid. Following correction of the problem, the reference material should be reanalyzed.

The Science and Monitoring Group QA Officer or designee will verify that the parameters listed on the laboratory COCs match electronic data EDDs and pdf reports and confirm that the proper parameters were analyzed and that there are no errors. If the lists of parameters on COCs do not match the EDDs and/or pdf reports, the Science and Monitoring QA Officer or designee will contact the EnviroMatrix Laboratory Director to resolve the issue and to take the appropriate corrective actions. Documentation on corrective actions will be placed in the Rainbow Creek project binder.

**Data Reporting**

Data tables are created and printed. Tables are reviewed for any errors or irregularities; if any are found it may be necessary to correct and reestablish the databases. Tables are submitted to Project Manager for review. The tables and reports are edited by at least two of the following three people; the Science and Monitoring QA Officer, the Project Manager, and/or the Laboratory Director. The report returns to the office staff for any corrections, and then the final draft is reviewed once again by the Science and Monitoring Group QA Officer. The Project Manager then signs the letter of transmittal. Finally, the data will be submitted to CEDEN.

# Element D3: Reconciliation With User Requirements

The Science and Monitoring Group QA Officer will review data to determine if data quality objectives (DQOs) have been met. If data do not meet the project's specifications, the QA Officer will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors. She will then suggest corrective action. It is expected that the problem could be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the quality assurance personnel will recommend appropriate modifications. Any revisions would need approval by the Jo Ann Weber, Project Manager.

The data collected by the Science and Monitoring Group will be analyzed using basic scientific and statistical analysis and used by the County of San Diego for water quality assessment. These data will be used to analyze water quality trends over time. The data collected from this project will be SWAMP and CEDEN compatible and assist in determining if target BMPs are effective over time. These objectives will be accomplished by comparing future water quality measurement results to the current established baseline water quality values.

All limitations on data use will be reported to end users in the Quarterly Monitoring Reports and in the Final Report.

# References

APHA, AWWA, and WEF, 1998. *Standard Methods for Examination of Water and Wastewater.* 20th edition.

California Environmental Data Exchange Network (CEDEN). 2012. http://www.ceden.org/

California Regional Water Quality Control Board San Diego Region. 2005. *Resolution No. R9-2005-0036. A Resolution Adopting an Amendment to the Water Quality Control Plan for the San Diego Region (9) to Incorporate Total Maximum Daily Loads (TMDLs) for Total Nitrogen and Total Phosphorus in the Rainbow Creek Watershed.* http://www.swrcb.ca.gov/rwqcb9/water_issues/programs/tmdls/rainbowcreek.shtml

San Diego Regional Water Quality Control Board. 2010. *CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs.* USEPA approval date: October 11, 2011. http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml

California Regional Water Quality Control Board San Diego Region. 2015. *Order No. R9-2013-0001 as Amended by Order Nos. R9-2015-0001 AND R9-2015-0100 NPDES No. CAS0109266 National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds within the San Dieio Region*. http://www.waterboards.ca.gov/sandiego/water_issues/programs/stormwater/docs/2015-1118_AmendedOrder_R9-2013-0001_COMPLETE.pdf

County of San Diego. 2013. *Sampling and Analysis Plan for Rainbow Creek Nutrient Reduction TMDL Implementation Water Quality Monitoring.*

County of San Diego. 2010. *Parcel-Based Characterization of Nutrient Sources in the Rainbow Creek Watershed. Final Report*. Prepared for the County of San Diego by Weston Solutions, Inc. 2433 Impala Drive, Carlsbad, CA.

MRCD, 1999b. *Willow Glen Basin Non-Point Source Nitrate Reduction Program, Final Report*. MRCD, Fallbrook, CA, November 1999.

State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP). 2013. *Quality Control and Sample Handling Guidelines*. http://www.waterboards.ca.gov/water_issues/programs/swamp/mqo.shtml

State Water Resources Control Board, Version 1.0, September 1, 2008. Surface Water Ambient Monitoring Program (SWAMP), *Quality Assurance Program Plan*. http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf

US EPA, 2002. *EPA Guidance for Quality Assurance Project Plans*. EPA QA/G-5.

US EPA, 2001. *EPA Requirements fo Quality Assurance Project Plans*. EPA QA/R-5.

US EPA, 2000. Environmental Response Team, Standard Operating Procedures for Manual Water Level Measurements. Available at: http://www.dem.ri.gov/pubs/sops/wmsr2043.pdf

# Appendix 1 – Field Data Sheet

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
9325 HAZARD WAY, SAN DIEGO, CA 92123

## FIELD SAMPLING DATASHEET

**New Site?** ☐ Yes ☐ No **Project:** Rainbow Creek 319(h) Grant

**GENERAL SITE DESCRIPTION**

| Site ID | | Site Type | Original | Sample Event ID | | Sample Event Type | | Field Screening |
|---|---|---|---|---|---|---|---|---|
| Location | Rainbow Creek @ | | | | | Watershed | Hydrologic Unit | 902 |
| Date | | Time | | Latitude | | | Hydrologic Area | 902.2 |
| Field Staff | | | | Longitude | | | Hydrologic Subarea (Optional) | 902.23 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| QC Sample | ☐ None | ☐ Orig-Dup | ☐ QC-Dup | ☐ Orig-Blank | ☐ QC-Blank | ☐ Field Standard | |
| Land Use (Primary) (Check one only) | ☐ Residential | ☐ Rural Resid. | ☐ Comm. | ☐ Indust. | ☐ Agr. | ☐ Parks | ☐ Open |
| Land Use (Secondary) (Optional, >10%) | ☐ Residential | ☐ Rural Resid. | ☐ Comm. | ☐ Indust. | ☐ Agr. | ☐ Parks | ☐ Open |
| Conveyance (Check one only) | ☐ Concrete Channel | ☐ Natural Creek | ☐ Earthen Channel | ☐ Manhole | ☐ Catch Basin | ☐ Outlet | |

**FLOW OBSERVED** ☐Yes ☐ No ☐ Ponded **REFERRAL #** ________ **DISCHARGE AREA** (Optional) ________

**GENERAL CONDITION**

**Weather** ☐ Sunny ☐ Partly Cloudy ☐ Overcast ☐ Fog **Last Rain** ☐ > 72 hours ☐ < 72 hours

**OBSERVATIONS** N/A

| | | | | | | |
|---|---|---|---|---|---|---|
| Odor | ☐ None | ☐ Musty | ☐ Rotten Eggs | ☐ Chemical | ☐ Sewage | ☐ Other |
| Color | ☐ None | ☐ Yellow | ☐ Brown (Silty) | ☐ White (Milky) | ☐ Gray | ☐ Other |
| Clarity | ☐ Clear | ☐ Slightly Cloudy | ☐ Opaque | | | ☐ Other |
| Floatables | ☐ None | ☐ Trash | ☐ Bubbles/Foam | ☐ Sheen | ☐ Fecal Matter | ☐ Other |
| Deposits | ☐ None | ☐ Coarse Particulates | ☐ Fine Particulates | ☐ Stains | ☐ Oily Deposits | ☐ Other |
| Vegetation | ☐ None | ☐ Limited | ☐ Normal | ☐ Excessive | | ☐ Other |
| Biology | ☐ None | ☐ Insects | ☐ Algae | ☐ Snails/Fish | ☐ Mussels/Barnacles | ☐ Other |

**FLOW MEASUREMENT** N/A

| Flowing Creek | T1 | T2 | T3 | Average | |
|---|---|---|---|---|---|
| Width | | | | | ft |
| Depth | | | | | ft |
| Velocity | | | | | ft/sec |
| Flow Rate | | | | | cfs |

**Evidence of Overland Flow?** ☐ Yes ☐ No ☐ Irrigation Runoff ☐ Other ________________

**Outlet** Diameter ________________ Liters/Second ________________

**Leaf Float** Distance__________ ft Time__________ sec

**FIELD MEASUREMENT** N/A

**Field Screening Sample Collected?** ☐ Yes ☐ No

**Is the sample filtered?** ☐ Yes ☐ No

**Analytical Lab Sample Collected?** ☐ Yes ☐ No

| Parameter | Reading | Parameter | Reading | Parameter | | 1st | Dil. Times | Dil. Reading | Final |
|---|---|---|---|---|---|---|---|---|---|
| pH (Unit) | | DO (mg/L) | | Phosphate ($PO_4$) | mg/L | | | | |
| Cond (mS/cm) | | Temp (°C) | | Nitrate ($NO_3$) | | | | | |
| Turb (NTU) | | Salinity (%) | | Ammonia ($NH_3$-N) | | | | | |

COMMENTS: ________________________________________________

________________________________________________

________________________________________________

________________________________________________

**Completed by**__________________

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
9325 HAZARD WAY, SAN DIEGO, CA 92123

## Land Use Types

1. **Residential**
   Single- and multi-family homes, mobile home parks, etc.
2. **Rural Residential**
   Single family homes located in rural areas with lot sizes of approximately 1 to 10 acres. Rural residential estates may have small orchards, fields or small storage buildings associated with the residential dwelling unit, etc.
3. **Commercial**
   Offices, schools, shopping centers, auto dealerships, government/civic centers, cemeteries, churches, libraries, post offices, fire/police stations, military use, jails, prisons, border patrol holding stations, dormitories, hotels, motels, resorts, and casinos, etc.
4. **Agricultural**
   Orchards, vineyards, nurseries, greenhouses, flower fields, dairies, livestock, poultry, equine ranches, row crops and grains, pasture, fallow, etc.
5. **Industrial**
   Shipbuilding, airframe, aircraft manufacturing, industrial parks, manufacturing uses such as lumber, furniture, paper, rubber, stone, clay, and glass; auto repair services/recycling centers; warehousing, wholesale trade; mining, sand and gravel extraction, salt evaporation; junkyard, dumps/landfills; auto wrecking/dismantling and recycling centers, etc.
6. **Parks**
   Recreation areas and centers, neighborhood parks, wildlife and nature preserves, golf courses, accessible sandy areas along the coast or major water bodies allowing swimming and picnicking, etc.
7. **Open**
   Vacant and undeveloped lands, etc.

## Watersheds

| HU | Watershed |
|---|---|
| 902 | Santa Margarita River |
| 903 | San Luis Rey River |
| 904 | Carlsbad |
| 905 | San Dieguito River |
| 907 | San Diego River |
| 909 | Sweetwater River |
| 910 | Otay River |
| 911 | Tijuana River |

## Action Levels

| Field Screening Analyte | Action Level |
|---|---|
| pH | <6.5 or >9.0 |
| Orthophosphate-P (mg/L) | 2.0 (**6.0 $PO_4$**) |
| Nitrate-N (mg/L) | 10.0 (**44.3 $NO_3$**) |
| Ammonia-N (mg/L) | **1.0** |
| Turbidity (NTU) | BPJ |
| Temperature (°F or °C) | BPJ |
| Conductivity (µS/cm) | BPJ |

| Laboratory Analyte | Action Level |
|---|---|
| MBAS (mg/L) | 1.0 |
| Oil and Grease (mg/L) | 15 |
| Diazinon & Chlorpyrifos (µg/L) | 0.5 |
| Dissolved Cd, Cu, Pb, Zn (µg/L) | CTR |
| Total Coliform (MPN/100 mL) | 50,000 |
| Fecal Coliform (MPN/100 mL) | 20,000 |
| Enterococcus (MPN/100 mL) | 10,000 |

**Sample Event Type:** Field Screening, Source ID, QC-Duplicate, QC-Blank, QC-Standard, and Confirmation.

# Appendix 2 – Photo Documentation Field Data Log

Project:

Location:

Date:

Photographer:

Team members:

| Photo # | Time | Photo Point ID | Photo Pt. Description & Location | Bearing to Subject | Subject Description |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## General Notes or Comments (weather, cloud cover, time of sunrise and sunset, other pertinent information):

# Appendix 3 - Laboratory Chain of Custody

**CHAIN-OF-CUSTODY RECORD**

**EnviroMatrix Analytical, Inc.**

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG#:
Client: County of San Diego
Attn: Kenneth Little
Sampler(s):
Address: 5510 Overland Ave., Suite 410
San Diego, CA 92123
Phone: (858) 694-2335 Fax: (858) 495-5263
Email: Kenneth.Little@sdcounty.ca.gov
Billing Address: same as above

Project ID: Rainbow Creek
Project#: Contract#:

**Requested Analysis**

| ID# | Client Sample ID | Sample Event ID | Sample Date | Sample Time | Sample Matrix | Container #/ Type | TDS | Nitrate | Nitrite | TKN | NH3 | Orthophosphate as P | Total Phosphate as P | Iron | Sulfate | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Matrix Codes: A – Air, DW – Drinking Water, GW – Groundwater, SW – Storm Water
WW – Wastewater, S – Soil, SED – Sediment, SD – Solid, T – Tissue, O – Oil, L – Liquid
Shipped By: □ Courier □ UPS □ FEDEX □ USPS □ Client Drop Off □ Other
*Turn-Around-Time: □ Same Day □ 24 hr □ 48 hr □ 3 day □ 4 day □ 5 day □ STD (7 day)
*Reporting Requirements: □ Fax □ PDF □ Excel □ Electronic EDF □ Hard Copy □ EDT
*Sample Disposal: □ By Laboratory □ Return to Client: S/H or Delivery □ Archive

| RELINQUISHED BY | DATE/TIME | RECEIVED BY |
|---|---|---|
| Signature: | | Signature: |
| Print: | | Print: |
| Company: | | Company: |
| Signature: | | Signature: |
| Print: | | Print: |
| Company: | | Company: |
| Signature: | | Signature: |
| Print: | | Print: |
| Company: | | Company: |

**Sample Integrity**

| | | |
|---|---|---|
| Correct Containers: Yes No N/A | | Containers Properly Preserved: Yes No N/A |
| Custody Seals Intact: Yes No N/A | | Temp @ Receipt:_______________ |
| COC/Labels Agree: Yes No N/A | | Sampled By: Client EMA Autosampler |

**Project/Sample Comments:**

# Appendix 4 - Daily Calibration Log Sheet for Horiba U-50 Series Multi-Parameter Meter

## Horiba U-10 Daily Calibration Log Sheet

**PRE-FIELD:**

CALIBRATED: BY________ DATE________ TIME_________ METER_____

| Calibration | | pH* | Cond. (mS/cm) | Turbidity (NTU) | DO (mg/L) | Temp. (°C) | Salinity (%) |
|---|---|---|---|---|---|---|---|
| Auto-Cal Solution | Std. Value | 4.00 | 4.49 | 0.0 | 8.52 | @ 22 | 0.23 |
| | Reading | | | | | | |
| pH 7 Solution | Std. Value | 6.86** | | | | | |
| | Reading | | | | | | |
| pH 10 Solution | Std. Value | 10.00 | | | | | |
| | Reading | | | | | | |

**POST-FIELD:**

CHECKED: BY________ DATE________ TIME_________ METER_____

| Calibration | | pH* | Cond. (mS/cm) | Turbidity (NTU) | DO (mg/L) | Temp. (°C) | Salinity (%) |
|---|---|---|---|---|---|---|---|
| Auto-Cal Solution | Std. Value | 4.00 | 4.49 | 0.0 | 8.52 | @ 22 | 0.23 |
| | Reading | | | | | | |
| pH 7 Solution | Std. Value | 6.86** | | | | | |
| | Reading | | | | | | |
| pH 10 Solution | Std. Value | 10.00 | | | | | |
| | Reading | | | | | | |

*pH readings should fall within +/- 0.5 units; all other parameters should fall within +/- 5% of standard values.
**Horiba pH 7 standard solution

# Appendix 5 - Horiba U-50 Series Multi-Parameter Meter SOP

## Using the Horiba Meter in the Field SOP

Following calibration, place the Horiba meter securely in its case for transport into the field. Upon arrival at the first sampling site, remove the Horiba meter from the case and turn it on. Gently place the probe in the water (should be fully submerged). Let the readings stabilize before they are recorded in the appropriate boxes on the field sheet. If the flow rate is <1 ft/sec, move the probe slowly up and down in the water column (being careful not to vigorously agitate the water, disturb bottom sediments or bang the probe into obstacles) in order to maintain flow across the dissolved oxygen (DO) sensor. If the water depth is not sufficient to completely submerge the probe, a bucket may be filled with sample water and the probe submerged in the bucket in order to obtain readings. Be sure and move the probe slowly up and down in the bucket to get an accurate DO reading. Readings for the following water quality parameters should be recorded: pH, temperature, conductivity, turbidity, dissolved oxygen and salinity. Press the **SELECT** key on the Horiba meter display panel to move from one parameter to the next. Remove the probe from the water and return it to its carrying case when done. Upon return to the lab and following the post-field check (see below), the probe should be rinsed in tap water and kept submerged in a container of tap water on the lab bench until next use.

## Daily Calibration Procedures

### Instrument Calibration and Frequency

The Horiba U-50 Series Multi-Parameter Meter is to be calibrated using the Auto-Calibration procedure described below prior to use in the field each day. Upon return to the lab from the field, the Horiba Meter will be checked using pH 7 solution and pH 10 solution and the results recorded. All measurements will be checked against the measurement quality objectives listed in Table 3. If results are out of the DQO range then probe must be calibrated using the manual two-point calibration methods. Manual two-point calibrations for dissolved oxygen, pH, conductivity and turbidity will be conducted quarterly during the months of January, April, July and October (Table 1). Following manual calibration the probe will be checked using the Horiba meter pH 4 (Autocal) solution and probe condition will be noted. All data will be recorded in the calibration data sheet. Auto-Calibration solution values are listed in Table 2 at standard temperature of 22$^{o}$C. Tables 4 and 5 list concentrations for pH and dissolved oxygen as they vary by temperature.

**Table 1: Calibration Frequency**

| Sensor | Auto calibration | Two-point Calibration | Post-Field Check? |
|---|---|---|---|
| pH | Daily | Quarterly | Yes, pH 7 and pH 10 |
| Dissolved oxygen | Daily | Quarterly | No |
| Conductivity | Daily | Quarterly | No |
| Turbidity | Daily | Quarterly | No |
| Temperature | Record Only | Check with Standard Thermometer | Yes |

**<u>Auto-calibration Procedure:</u>**

1. Rinse probe in tap water and dry
2. Using the **MODE** key put in **MAINT** mode then toggle to Set **S.SET**. Using the ↑↓ keys select to ***A*** for (Auto-salinity). Press **ENT** to complete salinity setting.
3. Place probe in beaker 2/3 full of standard *Autocal Horiba* pH 4 (Autocal) solution. Using the **MODE** key put in **MAINT** mode then toggle to **AUTO** sub-mode. Press **ENT** to initiate auto-calibration. Readout will automatically return to **MEAS** mode Calibrate the meter using the pH 4 (*Autocal*) solution.
4. Record readouts for all parameters in the Daily Calibration Logsheet.all data into the logsheet.
5. Remove the probe from the *Horiba* pH 4 solution, rinse in tap water, dry and place in pH 7 solution. Record pH value. Repeat this step with pH 10 solution.
6. Upon return from the field, checked probe using the *Horiba* pH 4 (Autocal) solution and pH 10 solution, record values in the Daily Calibration Logsheet, then rinse probe in tap water and place in a beaker of tap water for short-term storage.

**<u>Manual Two-point Calibrations:</u>**

**pH Calibration:**

pH calibration is done using two standard solutions of different pH values, one for the zero calibration, the other for the span calibration. Water Quality objectives for pH in surface waters for the San Diego Region are 6.5 to 9.0, therefore it is recommended to use pH 7 and pH10 solutions.

Zero Calibration:

- Use the pH 7 solution (**Must use pH7 solution**), check temperature of standard.
- Press **MODE**, select **MAINT** mode.
- Press **MODE** again to move the lower cursor to **ZERO**.
- Press **SELECT** to move the upper cursor to **pH**
- Select the appropriate pH value after the readout has stabilized (e.g. enter pH = 6.86 if temp. is 25°C; note that different brands of standard pH solutions may have different pH values at a given temperature; Table 3) using the ↑↓ keys.
- To complete pH zero calibration, press **ENT**. Record this value in the calibration data sheet.

Span Calibration:

- Rinse and dry probe and place in second standard solution (e.g.-pH 10).
- Use the **MODE** key to move the lower cursor to **SPAN**.
- Check the temperature of the standard solution and select the appropriate pH value after the readout has stabilized using the ↑↓ keys.
- To complete pH span calibration, press **ENT**. Record this value in calibration data sheet. Record all data into the logsheet.

Calibrate the meter using the pH 10 solution.
Record all data into the logsheet.

**Conductivity Calibration:**

The Horiba U-50 Series Multi-Parameter Meter automatically selects the proper range to measure conductivity. Therefore, manual calibration must be done for all three ranges used by the probe.

Zero calibration:

- Triple rinse probe in DI or distilled water. Shake off excess water and allow to air dry.
- Press **MODE** and move lower cursor to **ZERO** (done in air).
- Press **SELECT** and move upper cursor to **COND**
- Press the ↑↓ keys to set the readout to zero.
- To complete the zero COND calibration, press **ENT**. Record this value in the calibration data sheet.

Span calibration:

(use Horiba solutions in this order: Range 1, Range 2, Range 3)

- Triple-rinse and immerse probe in 58.7 mS/cm (5.87 S/cm) solution (Range 1).
- Press **MODE** and move lower cursor to **SPAN**
- Use the ↑↓ keys to select 58.7 mS/cm once readout has stabilized.
- Press **ENT** to complete the 58.7 mS/cm conductivity calibration. Record this value in the calibration data sheet.
- Repeat the above procedure using the 6.67 mS/cm (0.667 S/cm) and 0.718 mS/cm (71.8 S/cm) standard solutions (Ranges 2 and 3).

**Note: Shelf life of conductivity solutions is six months. Keep solutions tightly capped. Conductivity standards are "one-shot" solutions – do not reuse the standard (from SWAMP guidelines).**

**Turbidity calibration:**

When doing zero calibration it is crucial that you clean the probe thoroughly (insert brush several times in turbidity aperture).

Zero calibration:

- Triple-rinse probe and shake off excess water droplets immerse probe in DI or distilled water.
- Press **MODE** and move the lower cursor to **ZERO**.
- Press **SELECT** and move upper cursor to **TURB**.
- Use the ↑↓ keys to select 0.0 once readout has stabilized.
- Press **ENT** to complete the zero turbidity calibration. Record this value in the calibration data sheet.

Span calibration:

- Triple-rinse and immerse probe in 100 NTU standard solution.
- Press **MODE** and move lower cursor to **SPAN**.
- Use the ↑↓ keys to select 100 NTU once the readout has stabilized.
- Press **ENT** to complete the 100 NTU turbidity calibration. Record this value in the calibration data sheet.

**Note: Shelf life of turbidity solutions is six months.**

**DO calibration:**

DO calibration solution for the span calibration must be prepared fresh just prior to use.

Zero calibration:

- Make sure that the probe display "S.SET" is set to "A"
- Remove the sensor guard.

- Triple-rinse probe in tap water and immerse it in zero DO standard solution (fill the small graduated cylinder to just below the top). *This solution must be opened immediately before use.*
- Press **MODE** and move the lower cursor to **ZERO**.
- Press **SELECT** and move the upper cursor to **DO**.
- Use the ↑↓ keys to select 0.0 once the readout has stabilized.
- Press **ENT** to complete the zero DO calibration.

Span calibration:

- Fill a container with tap water, close lid and bubble air through it with an aquarium pump to saturate it with dissolved oxygen.
- Triple-rinse the probe and immerse it in the container of $O_2$-saturated water.
- Make sure the probe is set for freshwater by setting the S.SET Sub-Mode to 0.0%. Hit “enter”.
- Press **MODE** to move the lower cursor to **SPAN**.
- After the readout has stabilized, slowly move the probe up and down in the water and set the readout value to the appropriate DO value based on the temperature of the water (refer to Table 5: DO saturation at various temperatures).
- Press **ENT** to complete the SPAN calibration for DO. Record in the calibration data sheet.
- Set “S.SET” back to “A”
- Perform post-calibration check using Horiba pH 4 (Autocal), pH 7 and pH 10.

**Table 2: Calibration solutions and values at 22$^o$ C.**

| Parameter | pH 4 (Horiba) | pH7 (Horiba) | pH 7 (YSI) | pH 10 (YSI) |
|---|---|---|---|---|
| pH | 4.00 | 6.86 | 7.00 | 10.00 |
| Conductivity (mS/cm) | 4.49 | | | |
| Turbidity (NTU) | 0 | | | |
| DDO (mg/L) | 8.52 | | | |

**Table 3: Measurement Quality Objectives for Accuracy and Precision**

| Parameter | Value | Lower Limit | Upper Limit |
|---|---|---|---|
| | 4.00* | 3.50 | 4.50 |
| | 6.86* | 6.36 | 7.36 |
| pH (± 0.5 units) | 10.0 | 9.50 | 10.50 |
| DO (+/- 5%) | 8.52 | 8.09 | 8.95 |
| Conductivity | 4.49 | 4.27 | 4.71 |
| Turbidity | 100 | 95 | 105 |

*Standard reference values differ depending on manufacturer.

**Table 4: Standard pH values at different temperatures**

| Temperature (°C) | pH 4 (Horiba) | pH 4 (YSI) | pH 7 (Horiba) | pH 7 (YSI) | pH10 (Horiba) | pH 10 (YSI) |
|---|---|---|---|---|---|---|
| 15 | 4.00 | 4.00 | 6.90 | 7.05 | | 10.12 |
| 20 | 4.00 | | 6.88 | | 10.06 | |
| 22 | 4.00 | | | | 10.03 | |
| 25 | 4.01 | | 6.86 | | 10.01 | |

**Table 5: Dissolved Oxygen at Various Temperatures**

| Temperature (°C) | Dissolved Oxygen (mg/L) | + 5% | - 5% |
|---|---|---|---|
| 15 | 9.76 | 10.25 | 9.27 |
| 16 | 9.56 | 10.04 | 9.08 |
| 17 | 9.37 | 9.84 | 8.90 |
| 18 | 9.18 | 9.64 | 8.72 |
| 19 | 9.01 | 9.46 | 8.56 |
| 20 | 8.84 | 9.28 | 8.40 |
| 21 | 8.68 | 9.11 | 8.25 |
| 22 | 8.53 | 8.96 | 8.10 |
| 23 | 8.39 | 8.81 | 7.97 |
| 24 | 8.25 | 8.66 | 7.84 |
| 25 | 8.11 | 8.52 | 7.70 |
| 26 | 7.99 | 8.39 | 7.59 |
| 27 | 7.87 | 8.26 | 7.48 |
| 28 | 7.75 | 8.14 | 7.36 |
| 29 | 7.64 | 8.02 | 7.26 |
| 30 | 7.53 | 7.91 | 7.15 |

## Instrument Inspection and Maintenance

**Table 6: Routine Sensor Replacement**

| Sensor | Replacement Frequency |
|---|---|
| pH | Once a year |
| Dissolved oxygen | Twice a year |
| Reference | Once a year |

### Routine Maintenance

Normal probe maintenance on a daily basis will include cleaning of turbidity and conductivity sensors.

Temperature Sensor:

Annually check the temperature readout of the probe against another thermometer. If temperature readout is not within 0.2 $^{o}$C then replace entire probe.

pH Sensor:

Visually check sensor. If cracked or if not meeting DQOs then replace following the manufactures procedures.

Conductivity Sensor:

Remove Conductivity Sensor guard and carefully use a soft brush to clean off any dust from the sensor unit. Replace guard before taking measurements.

Turbidity Sensor:

Turbidity sensor is a glass tube. Wash out the tube and remove stains carefully, using tap water and a bottle brush. Be careful not to scratch the inside of the glass tube.

Dissolved Oxygen Sensor:

Check sensor to make sure DO membrane has not been broken. If sensor is defective, replace sensor following the manufactures procedures. Dissolved oxygen probe shall routinely be replaced every six months or as necessary to meet DQO.

Reference Sensor:

Reference sensor will be recharged once every two months or more frequently if needed. If reference sensor has a “salt crust”, replace solution using procedure below.

Reference Sensor Recharge:

- Remove the liquid-junction rubber cap from the reference sensor, and pour out the old solution.
- Fill reference sensor completely with new reference solution. Make sure there are no air bubbles.
- Replace the liquid-junction rubber cap.
- Carefully wash off all excess reference solution from the probe.

# Horiba U-50 Series Multi-Parameter Meter Daily Calibration Log Sheet

**PRE-FIELD:**

**CALIBRATED:** BY________ DATE________ TIME_________ METER_____

| Calibration | | pH* | Cond. (mS/cm) | Turbidity (NTU) | DO (mg/L) | Temp. ($^o$C) | Salinity (%) |
|---|---|---|---|---|---|---|---|
| Auto-Cal Solution | Std. Value | 4.00 | 4.49 | 0.0 | 8.52 | @ 22 | 0.23 |
| | Reading | | | | | | |
| pH 7 Solution | Std. Value | 6.86** | | | | | |
| | Reading | | | | | | |
| pH 10 Solution | Std. Value | 10.00 | | | | | |
| | Reading | | | | | | |

**POST-FIELD:**

**CHECKED:** BY________ DATE________ TIME_________ METER_____

| Calibration | | pH* | Cond. (mS/cm) | Turbidity (NTU) | DO (mg/L) | Temp. ($^o$C) | Salinity (%) |
|---|---|---|---|---|---|---|---|
| Auto-Cal Solution | Std. Value | 4.00 | 4.49 | 0.0 | 8.52 | @ 22 | 0.23 |
| | Reading | | | | | | |
| pH 7 Solution | Std. Value | 6.86** | | | | | |
| | Reading | | | | | | |
| pH 10 Solution | Std. Value | 10.00 | | | | | |
| | Reading | | | | | | |

***pH readings should fall within +/- 0.5 units; all other parameters should fall within +/- 5% of standard values.**
****Horiba pH 7 standard solution**

# Horiba U-50 Series Multi-Parameter Meter Quarterly Calibration Logsheet

**CALIBRATED** BY________ DATE________ TIME_________ METER_____

**Manual Two-Point Calibration Table**

| Parameter | Range | Manufacturer | Lot No. | Date Opened | Expiration Date* | Std. Value | Temp (°C) | Initial Value | Calib. Value |
|---|---|---|---|---|---|---|---|---|---|
| pH | Zero | | | | | | | | |
| | Span | | | | | | | | |
| Conductivity (mS/cm) | Zero | | | | | | | | |
| | Range 3 | | | | | | | | |
| | Range 2 | | | | | | | | |
| | Range 1 | | | | | | | | |
| Turbidity (NTU) | Zero | | | | | | | | |
| | Span | | | | | | | | |
| Dissolved Oxygen (mg/L) | Zero | | | | | | | | |
| | Span | | | | | | | | |

**Post Calibration Check Using Horiba pH 4 Solution**

| Calibration | pH | Cond. (mS/cm) | Turbidity (NTU) | DO (mg/L) | Temp. (°C) | Salinity (%) |
|---|---|---|---|---|---|---|
| Standard Solution Value | 4.00 | 4.49 | 0.0 | 8.52 | @ 22 | 0.23 |
| Reading | | | | | | |
| pH 7 | | N/A | N/A | N/A | | N/A |
| pH 10 | | N/A | N/A | N/A | | N/A |

**Notes on Probe Condition/Replacement:**_______________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________
_________________________________________________

# Appendix 6 - Flow Meter SOP

## FLOW MEASUREMENT PROCEDURES

A flow measurement should be made during each site visit where flowing water is observed. Flow measurements can be used to estimate pollutant mass loading, prioritize storm drains for future investigations, or to identify significant changes in flow that may be indicative of an illegal release upstream. Since a majority of sample locations lack a permanent flow measurement installation, several field methods may be employed to estimate flow rate. If water is ponded, take width, length, and depth and record velocity as zero (0).

**Velocity-area method -** The most practical method for measuring the discharge of a stream is the velocity-area method. This method requires the physical measurement of the cross-sectional area and the velocity of the flowing water. Discharge is determined as the product of the area times the velocity.

Discharge ($ft^3$/sec) = Velocity (ft/sec) x Depth (ft) x Width (ft)

Using the Global Flow Probe, measure the velocity of the water flow (see flow probe instruction in Appendix 6). Use the measurement marks on the probe to measure the stream width and depth. Note: The probe markings are in tenths of a foot, therefore you read directly from the markings and do not need to make any conversions. Record results on the datasheet; the Dry Weather database will calculate the discharge flow.

**Fill a bottle method -** If conducting an IC/ID investigation on an outfall, staff should record information on the diameter of an outfall for the determination of the discharge flow. The rate can be determined by measuring the length of time it takes to fill a 1-Liter bottle. This method is very helpful for low-flow situations.

**Partially filled pipe method** - Another method for measuring flow is the partially filled pipe method. This method is helpful when you have a substantial flow coming from an outfall. For this method all measurements must be converted to a common unit before calculation (ft, in, or cm). Measure the water depth and inside pipe diameter and apply the following formula using the partially filled pipe formula chart in Table 1.

- Let D = water depth.
- Let d = *inside* pipe diameter
- Calculate D/d.
- Find the tabulated (Ta) value on the partially filled pipe formula chart below using the D/d value. (i.e. - if D/d = 0.263 then Ta =0.1623).
- Find the area using the formula
  $a = Ta*d^2$.
- Multiply area (a) by the water velocity.
- Convert to desired value.

**Table 1: Partially Filled Pipe Formula Chart**

**Calculating the Area (a) of the Cross Section of a Circular Pipe Flowing Partially Full**

D = Depth of water a = area of water in partially filled pipe
d = diameter of the pipe Ta = Tabulated Value Then a = Ta*d2

| D/d | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0.0** | 0.0000 | 0.0013 | 0.0037 | 0.0069 | 0.0105 | 0.0147 | 0.0192 | 0.0242 | 0.0294 | 0.0350 |
| **0.1** | 0.0409 | 0.0470 | 0.0534 | 0.0600 | 0.0668 | 0.0739 | 0.0817 | 0.0885 | 0.0951 | 0.1039 |
| **0.2** | 0.1118 | 0.1199 | 0.1281 | 0.1365 | 0.1440 | 0.1535 | 0.1623 | 0.1711 | 0.1800 | 0.1890 |
| **0.3** | 0.1982 | 0.2074 | 0.2187 | 0.2280 | 0.2355 | 0.2450 | 0.2540 | 0.2642 | 0.2780 | 0.2836 |
| **0.4** | 0.2934 | 0.3032 | 0.3130 | 0.3220 | 0.3328 | 0.3428 | 0.3527 | 0.3627 | 0.3727 | 0.3827 |
| **0.5** | 0.3980 | 0.4030 | 0.4130 | 0.4230 | 0.4330 | 0.4430 | 0.4520 | 0.4620 | 0.4720 | 0.4820 |
| **0.6** | 0.4920 | 0.5020 | 0.5120 | 0.5210 | 0.5310 | 0.5400 | 0.5500 | 0.5590 | 0.5690 | 0.5780 |
| **0.7** | 0.5870 | 0.5960 | 0.6050 | 0.6140 | 0.6230 | 0.6320 | 0.6400 | 0.6490 | 0.6570 | 0.6660 |
| **0.8** | 0.6740 | 0.6810 | 0.6890 | 0.6970 | 0.7040 | 0.7120 | 0.7190 | 0.7250 | 0.7320 | 0.7360 |
| **0.9** | 0.7450 | 0.7500 | 0.7560 | 0.7610 | 0.7660 | 0.7710 | 0.7750 | 0.7790 | 0.7820 | 0.7840 |

**[Flowing Creek]** Record the creeks' water flow characteristics using the hand held stick flow meter (FP-101 or FP-201). Record the waters' "Width", "Depth", and "Velocity" in the appropriate box on the field sheet using the measurement scale on the side of the stick flow meter (note: the scale is shown in tenths of a foot and not in inches). If the water is ponded record "0" (zero) for the "Velocity" and estimate the "Length" of the pond and record in the appropriate box on the field sheet. If the flow is too slow or small to be measured with the stick flow meter, then a "Leaf Float" estimation can be used to determine the velocity. The leaf float method is conducted by floating a small leaf on top of the water and noting the drift, record "Distance" in feet and "Time" in seconds. The final alternate flow measurement technique is accomplished by recording the time need to fill a container with a known volume.

**Flow Probe User Instructions (Global Water Model)**

1. The FP101 probe handle is a two-piece rod expandable from 3' to 6'. The FP201 probe handle is a three-piece rod expandable from 5' to 15'. To expand the rod for correct placement in flow, loosen the locking nut on the handle, pull out the top piece, and retighten the nut.

2. Make sure the Flow Probe's propeller turns freely by blowing strongly on the prop. Remove any accumulated debris (e.g. - magnetic sediment).

3. Scroll with the bottom button until the "AVGSPEED" for velocity appears on the bottom of the screen. Push the top button for three (3) seconds to reset the display. The display will read in feet/second units.

4. Point the propeller directly into the flow you wish to measure. Face the arrow inside the prop housing **downstream** (arrow points in the direction of flow). Raised bump on outside of housing should be pointed into the flow.

5. For small streams, the probe can be moved slowly and smoothly throughout the flow during average velocity measurement. Move the probe smoothly and evenly back and forth from the edges of the stream and from top to bottom of the flow so that the probe stays at each point in the flow for approximately the same amount of time. Keep moving the probe for 20-40 seconds to obtain an accurate average value that accounts for surging. (Move the probe as if you were spray painting and attempting to get an even coat of paint over the entire surface.).

   The Flow Probe uses true velocity averaging. Reset "AVGSPEED" before starting a new measurement. One reading is taken per second, and a continuous average is displayed. For example, after 10 seconds, 10 readings are totaled and then divided by 10 and this average is displayed. Once the average reading becomes steady, the true average velocity of the stream is obtained. When you pull the probe from the water, this average value is frozen on the display until it is reset. Record this value in the proper cell on the field sheet.

6. Measure/calculate the cross-sectional area of your flow stream in square feet (Note: optional, the database will do this calculation). The average velocity (calculated with the Flow Probe in feet/second) times the cross-sectional area (square feet) equals flow in cubic feet per second (cfs), or Q = V x A. If the propeller gets fouled while measuring flow, clean it until the prop turns freely and start over.

# Appendix 7 - Photo Documentation SOP

## Introduction:

Photographs provide a qualitative, and potentially semi-quantitative, record of conditions in a watershed or on a water body. Photographs can be used to document general conditions on a reach of a stream during a stream walk, pollution events or other impacts, assess resource conditions over time, or can be used to document temporal progress for restoration efforts or other projects designed to benefit water quality. Photographic technology is available to anyone and it does not require a large degree of training or expensive equipment. Photos can be used in reports, presentations, or uploaded onto a computer website or GIS program. This approach is useful in providing a visual portrait of water resources to those who may never have the opportunity to actually visit a monitoring site.

## Equipment:

Use the same camera to the extent possible for each photo throughout the duration of the project. Either 35 mm color or digital color cameras are recommended, accompanied by a telephoto lens. If you must change cameras during the program, replace the original camera with a similar one comparable in terms of media (digital vs. 35 mm) and other characteristics. A complete equipment list is suggested as follows:

Required:

- Camera and backup camera
- Folder with copies of previous photos (do not carry original photos in the field)
- Timepiece
- Extra digital disk capacity (whichever is applicable)
- Extra batteries for camera (if applicable)

# Appendix 8 - Sample Collection SOP

## SCOPE AND APPLICATION

This protocol describes the techniques used to collect water samples in the field in a way that neither contaminates, loses, or changes the chemical form of the analytes of interest. The samples are collected in the field into previously cleaned and tested (if necessary) sample bottles of a material appropriate to the analysis to be conducted. Pre-cleaned sampling equipment is used for each site, whenever possible and/or when necessary. Appropriate sampling technique and measuring equipment may vary depending on the location, sample type, sampling objective, and weather.

## SUMMARY OF METHOD

Appropriate sample containers and field measurement gear as well as sampling gear are transported to the site where samples are collected according to each sample's protocol. Water velocity, turbidity, temperature, pH, conductivity, dissolved oxygen as well as other field data are measured and recorded using the appropriate equipment, but these field data measurement protocols are provided in Appendices 5 and 6 of this document. Samples are put on ice and appropriately shipped to the processing laboratories. This procedure has been modified from the "Texas Natural Resources Conservation Commission's Procedure Manual for Surface Water Quality Monitoring", with major input from the "USGS NAWQA protocol for collection of stream water samples", for which due credit is herewith given.

## WATER SAMPLE COLLECTION

Water chemistry and bacteriological samples, as requested, are collected at the same location. *Water samples are best collected before any other work is done at the site*. If other work (i.e., sediment sample collection, flow measurement or biological/habitat sample collection or assessment) is done prior to the collection of water samples, it might be difficult to collect representative samples for water chemistry and bacteriology from the disturbed stream. Care must be taken, though, to not disturb sediment collection sites when taking water samples.

For stream samples, the centroid of flow must be accessible for sampling physicochemical parameters, either by bridge, extendable sampling pole, boat or wading. Sampling from the shoreline of any water body is the least acceptable method.

### Collection of Water Samples for Analysis of Conventional Constituents:

In most streams, near-surface water is representative of the water mass. A water sample for analysis of conventional constituents is collected by the grab method in most cases, immersing the container beneath the water surface to a depth of 0.1 m. Sites accessed by bridge can be sampled with a sample container-suspending device. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge. Care must also be taken to rinse the device between stations. If the centroid of the stream cannot be sampled by wading, sampling devices can be attached to an extendable sampling pole.

### Sampling Methods Requirements:

Field personnel will adhere to recommended SWAMP sample collection protocols or approved and documented alternative protocols, in order to insure the collection of representative, uncontaminated (contaminants not introduced by the sample handling procedure itself) water samples for laboratory analyses. If protocols are revised or altered, the deviations from the standard protocols must be documented.

Briefly, the key aspects of quality control associated with sample collection for eventual chemical analyses are as follows: 1) field personnel will be thoroughly trained in the proper use of sample collection gear and will be able to distinguish acceptable versus unacceptable water samples in accordance with pre-established criteria; 2) field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (e.g., engine exhaust, winch wires, deck surfaces, ice used for cooling); 3) sample gear and utensils which come in direct contact with the sample will be made of non-contaminating materials (e.g., glass, high-quality stainless steel and/or Teflon™, according to protocol) and will be thoroughly cleaned between sampling stations according to appropriate cleaning protocol; 4) sample containers will be of the recommended type and will be free of contaminants (i.e., pre-cleaned); and 5) conditions for sample collection, preservation and holding times will be followed.

After collection, field-collected samples will be stored at 4˚C until arrival at the contract laboratory.

**Collection of Water Samples for Analyzing Bacteria:**

Pathogen monitoring in SWAMP will typically include sampling for pathogen indicator organisms (fecal and total coliform bacteria, *E. coli*, and *Enterococcus* bacteria). *Note*: Samplers must wear gloves when collecting any pathogen samples in order to prevent introduced bacterial contamination.

Samples analyzed for bacteria will be collected as near-surface grab samples. Sampling for bacteria will in most cases be performed according to the sampling procedures detailed for Standard Methods 9221B and 9221E (APHA *et al*. 1998). In brief, the sampling procedures are summarized as follows:

- Sample containers should be cleaned and sterilized using procedures described in Standard Methods 9030 and 9040 (APHA *et al.* 1998). In most cases, these containers are provided by the laboratories conducting the analyses. Alternatively, Whirl-pak bags may also be used, per protocol.
- For waters suspected to contain a chlorine residual, sample bottles should contain a small amount of sodium thiosulfate ($Na_2S_2O_3$) sufficient to neutralize bactericidal activity. In most cases, bottles provided by contract laboratories already contain the sodium thiosulfate as a precautionary measure. For water containing high concentrations of copper or zinc, sample bottles should contain sufficient EDTA solution to reduce metal toxicity. *Note*: These conditions are rare in surface waters.
- Sample bottles may be glass or plastic (e.g. polypropylene) with a capacity of at least 100 ml, or again, Whirl-pak bags. After sterilization, sample bottles should be kept closed until they are to be filled.
- When removing caps from sample bottles, be careful to avoid contaminating inner surface of caps or bottles.
- Using aseptic techniques, fill sample bottles (or Whirl-pak bags), leaving sufficient air space to facilitate mixing by shaking. Do not rinse bottles.

- Recap bottles tightly.

If at any time the sampling crew suspects that the sample or sampling container has been contaminated, the sample should be re-collected into a new sample container.

**If bacteriological samples are to be used for regulatory compliance purposes, then samples must be kept at 4˚C (dark) and transported to the laboratory so that the analysis begins within 6 hours of collection.**

In the field, all samples will be packed in wet ice or frozen ice packs during shipment, so that they will be kept at approximately 4˚C. Samples will be transported in insulated containers. All caps and lids will be checked for tightness prior to placement in the cooler. All samples will be handled, prepared, transported and stored in a manner so as to minimize bulk loss, analyte loss, contamination or biological degradation. Sample containers will be clearly labeled with an indelible marker. Water samples will be kept in Teflon™, glass, or polyethylene bottles and kept cool at a temperature of 4˚C until analyzed. Maximum holding times for specific analyses are listed in the Summary Table at the end of this SOP.

**Chain of Custody:**

Chain-of-custody procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. A complete chain-of-custody form is to accompany the transfer of samples to the analyzing laboratory.

**Field Data Logsheet:**

Field crews shall be required to keep a field data logsheet for each sampling event. The following items should be recorded on the field data logsheet for each sampling event:

- time of sample collection;
- sample ID numbers, including etched bottle ID numbers for Teflon™ mercury sample containers and unique IDs for any replicate or blank samples;
- the results of any field measurements (temperature, D.O., pH, conductivity, turbidity) and the time that measurements were made;
- qualitative descriptions of relevant water conditions (e.g. color, flow level, clarity) or weather (e.g. wind, rain) at the time of sample collection;
- a description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality.

The field crews shall have custody of samples during field sampling. Chain of custody forms will accompany all samples during shipment to contract laboratories. All water quality samples will be transported to the analytical laboratory directly by the field crew or by overnight courier.

**Field Duplicates** - Duplicate samples will be collected for all parameters at an annual rate of 1 per sampling event as defined in the Work Plan. The duplicate sample will be collected in the same manner and as close in time as possible to the original sample. This effort is to attempt to examine field homogeneity as well as sample handling, within the limits and constraints of the situation.

The following general information applies to all types of water samples, unless noted otherwise:

**Sample Collection Depth**

**Sub-Surface Grab Sample** Samples are collected at 0.1m below the water surface. Containers should be opened and re-capped under water in most cases.

**Depth-integrated Sample** If a depth-integrated sample is taken, the sample is pumped from discrete intervals within the entire water column.

**Surface Grab Sample** Samples are collected at the surface when water depth is <0.1m.

**Where to Collect Samples**

Water samples are collected from a location in the stream where the stream visually appears to be completely mixed. Ideally this would be at the centroid of the flow (*Centroid* is defined as the midpoint of that portion of the stream width, which contains 50% of the total flow), but depth and flow etc. do not always allow centroid collection. For stream samples, the sampling spot must be accessible for sampling physicochemical parameters, either by bridge, boat or wading. Sampling from the shoreline of any water body (meaning standing on shore and sampling from there) is the least acceptable method, but in some cases is necessary.

In reservoirs, lakes, rivers, and coastal bays, samples are collected from boats at designated locations provided by RWQCB's.

**Sampling Order if Multiple Media are Requested to be Collected**

The order of events at every site has to be carefully planned. For example, if sediment is to be taken, the substrate can not be disturbed by stepping over or on it; water samples can not be taken where disturbed sediment would lead to a higher content of suspended matter in the sample. *For the most part, water samples are best collected before any other work is done at the site*. This information pertains to walk-in sampling.

**Sample Container Labels**

Label each container with the station ID, sample code, matrix type, analysis type, project ID, and date and time of collection (in most cases, containers will be pre-labeled). After sampling, secure the label by taping around the bottle with clear packaging tape.

**Procedural Notes**

For most water samples (not for organics, inorganics or bacteria), prior to collecting sample, rinse the container with ambient water, unless protocol for specific analytical procedure dictates otherwise.

If applicable to the sample and analysis type, the sample container should be opened and re-capped under water.

**Sample Short-term Storage and Preservation**

Properly store and preserve samples as soon as possible. Usually this is done immediately after returning from the collection by placing the containers on bagged, crushed or cube ice in an ice chest. Sufficient ice will be needed to lower the sample temperature to at least 4°C within 45 minutes after time of collection. Sample temperature will be maintained at 4°C until delivered to the laboratory. Care is taken at all times during sample collection, handling and transport to prevent exposure of the sample to direct sunlight. Samples are preserved in the laboratory, if necessary, according to protocol for specific analysis (acidification in most cases). Pre-preserved containers may be supplied by the contract analytical laboratory.

**Field Safety Issues**

Proper gloves must be worn to prevent contamination of the sample and to protect the sampler from environmental hazards (disposable polyethylene, nitrile, or non-talc latex gloves are recommended, **however, metals and mercury sample containers can only be sampled and handled using polyethylene gloves as the outer layer**). Wear at least one layer of gloves, but two layers help protect against leaks. One layer of shoulder high gloves worn as first (inside) layer is recommended to have the best protection for the sampler. Safety precautions are needed when collecting samples, especially samples that are suspected to contain hazardous substances, bacteria, or viruses.

**Sample Handling and Shipping**

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed inside a large plastic bag inside the ice chest for shipping. The bag can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the lab beyond the holding time.

Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

**Chain of Custody Forms (COC)**

Every shipment must contain a complete Chain of Custody Form (see Appendix D) that lists all samples taken and the analyses to be performed on these samples.

Make sure you include a COC for every laboratory you ship to, every time you send a shipment.

Include region and trip information as well as any special instructions to the laboratory.

The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy.

Samples collected should have the salinity (in ppt), depth of collection, and date/time collected on every COC.

Write a comment on this form, if you want to warn the laboratory personnel about a possibly hazardous sample, or samples, which contain high chlorine or organic levels.

**Field QC Samples for Water Analyses**

Field duplicates are currently submitted at an annual rate of 10% (but are required to be submitted at an annual rate of at least 5%). Field travel blanks are required for volatile organic compounds at a rate of one per cooler shipped. Field blanks are required for trace metals (including mercury and methyl mercury), DOC, and volatile organic compounds in water at a rate of 5%.

**Field Site Data Sheets**

Each visited field site requires a completed Field Data Sheet, even if no samples are collected (i.e. at a site which is found to be dry). If water samples are taken, a Water Quality Data Sheet must be filled out as well.

**General Pre-Sampling Procedures**

**Instruments**. All instruments must be in proper working condition. Make sure all calibrations are current. Instruments should be calibrated every morning prior to sampling. Conductivity should also be calibrated between stations if there is a significant change in salinity.

**Sample Storage Preparations**. A sufficient amount of cube ice, blue ice and dry ice as well as enough coolers of the appropriate type and size must be brought into the field, or sources for purchasing these supplies identified in advance.

**Sample Container Preparation**. After arriving at the sample station, pack all needed sample containers for carriage to the actual collection site, and label them with a pre-printed label containing Station ID, Sample Code, Matrix info, Analysis Type info, Project ID and blank fields for date and time (if not already pre-labeled).

**Safety Gear.** Pack all necessary safety gear like waders, protective gloves and safety vests.

**Walk to the site**. For longer hikes to reach a sample collection site, large hiking backpacks are recommended for transport of gear, instruments and containers. Tote bins can be used, if the sampling site can be accessed reasonably close to the vehicle.

**GPS**. At the sampling site, compare/record reconnaissance GPS reading with current site reading and note differences. GPS coordinates should be in Decimal Degrees i.e. 38.12345 -117.12345.

## Summary of Sample Container, Volume, Initial Preservation, and Holding Time Recommendations for Water Samples

| **Parameters for Analysis in WATER Samples** | **Recommended Containers (all containers pre-cleaned)** | **Typical Sample Volume (ml)** | **Initial Field Preservation** | **Maximum Holding Time (analysis must start by end of max)** |
|---|---|---|---|---|
| **Conventional Constituents in Water** | | | | |
| **Ortho-phosphate ($OPO_4$)** | Polyethylene bottles (see **NOTE**[(1)] below) | 150 ml | Cool to 4°C, dark | 48 hours at 4°C, dark |
| **Nitrate + Nitrite (00630) ($NO_3$ + $NO_2$)** | Polyethylene bottles (see **NOTE**[(1)] below) | 150 ml | Cool to 4°C, dark | 48 hours at 4°C, dark |
| **Total Keldjahl Nitrogen (TKN)** | Polyethylene bottles (see **NOTE**[(1)] below) | 600 ml | Cool to 4°C, dark | Recommend: 7 days Maximum: 28 days Either one at 4°C, dark |
| **Total Dissolved Solids (TDS)** | Polyethylene bottles (see **NOTE**[(1)] below) | 1000 ml | Cool to 4°C, dark | 7 days at 4°C, dark |
| **Ammonia ($NH_3$)** | Polyethylene bottles (see **NOTE**[(1)] below) | 500 ml | Cool to 4°C, dark | 48 hours at 4C dark; if acidify, 28 days at 4°C, dark |
| **Total Phosphorus ($TPO_4$)** | Polyethylene bottles (see **NOTE**[(1)] below) | 300 ml | Cool to 4°C, dark | 28 days at 4°C, dark |

**(1)NOTE:**
**The volume of water necessary to collect in order to analyze for the above constituents is typically combined in four 1-liter polyethylene bottles, which also allows enough volume for possible re-analysis and for conducting lab spike duplicates. This is possible since the same laboratory is conducting all of the above analyses; otherwise, individual volumes apply.**

# Appendix 9 - Laboratory COC SOP

## <u>How to Fill Out a Chain of Custody (COC) Form SOP:</u>

Before leaving for the field, make sure you have at least two copies of the appropriate chain of custody (COC) form for the project for which you will be collecting water samples. Also bring carbon paper if samples are to be picked up in the field by the analytical laboratory courier. To save some time, you may want to fill in the sample I.D. and date columns on the COC prior to departure.

If necessary, please refer to a previously filled out chain of custody for an example of a properly completed COC form. All field staff should sign the form on the signature line below the project name. A separate line on the COC should be filled out for each site sampled as well as for any duplicates. The sample I.D. column should have all the sites where samples were taken listed. The sample date should be entered. The time each sample was taken should be entered using 24-hour clock format (e.g. - 4:00 p.m. should be entered as 1600). Enter “water”, sediment”, etc. as appropriate in the matrix column. The sample description is the event number (event numbers are unique for each sample). An “X” should be placed in the boxes below all parameters that samples were taken for. The total number of bottles filled for each site should be entered (Enter a total at the bottom of the column once all sampling has been completed. This number should match the actual number of bottles collected). Enter date and page numbers in the upper right corner.

All samplers should print and sign their name on the first two lines of the signature record. “County of San Diego” should be entered immediately to the right, along with the time and date of sample transfer.

The box marked “cool” should be checked under “sample conditions” (lower right portion of COC form), since the samples should be kept on ice at all times.

Once all the appropriate information and signatures have been entered on the COC and checked, a copy should be made and retained by the sampler(s). The original should be given to the courier along with the samples.

# Appendix 11- Database Entry SOP

### Before Starting

1. Organize the field sheets by sample event ID number.
2. Review each field sheet for accuracy and understanding of the chain of events.

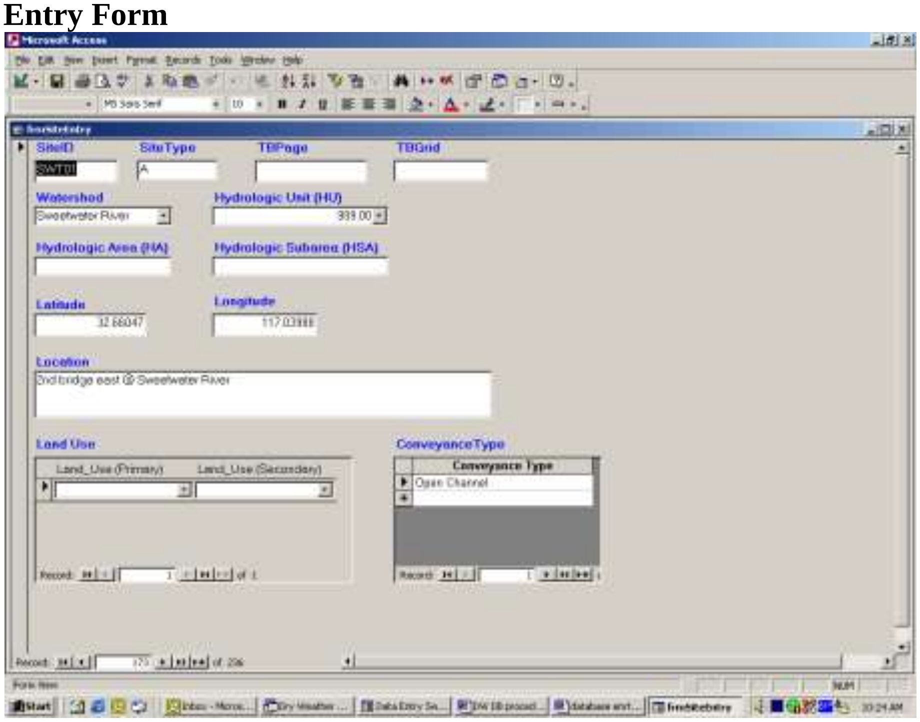
### <u>Database Entry Procedures</u>

### General Site Description Information

It is important to go through this step for each sample site prior to entering in the data.

1. Open Dry Weather Database; Database will open to Main Switchboard.
2. Click on [Enter Data]
3. Click on [Add a new dry weather monitoring site], a site entry form will appear. Place cursor in the [SiteID] box and press ctrl F (find function) and enter the site ID you are about to enter data for, press [find next]. The database will take you to the first entry for the sample site. Check [SiteType] to see if this is correct, if not, move through the next records until this matches the site location you are interested in. If you cannot find the Site Type you are looking for, go to Step 4. Check that all fields are completed. Update if necessary with Thomas Brothers Page and grid number, Hydrologic unit information, Lat./Long. (please add the negative sign for the Long.), Location, Land Use and Conveyance type (see Form 1 below).

**Form 1: Site Entry Form**



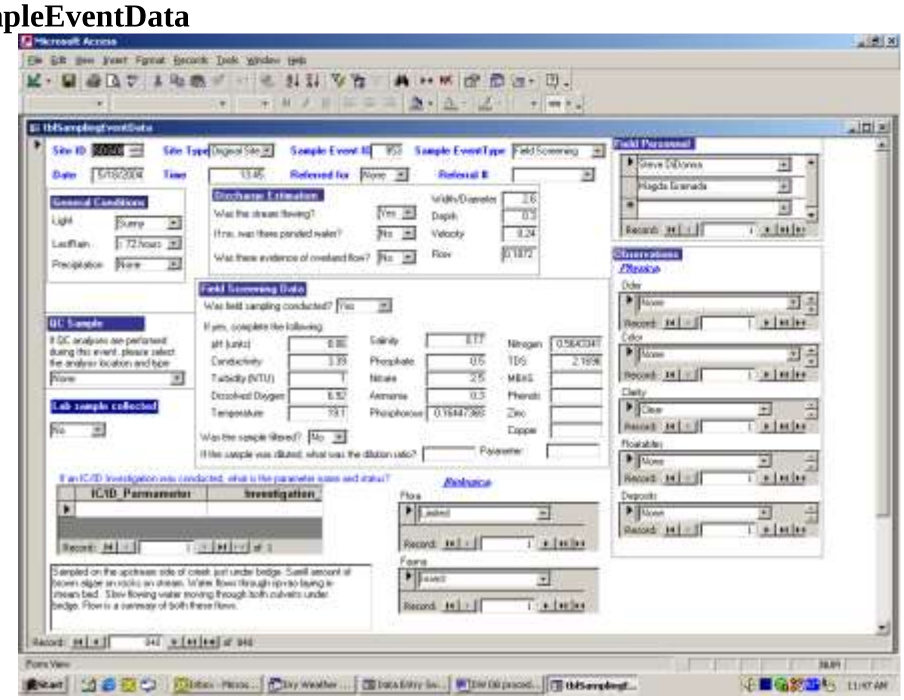

4. To enter a new Site record, press the new record button at the bottom of the entry form. Enter in all the new site information. Press save.

5. Close site entry form after saving, go back to [Data Entry Switchboard]
6. Mark field datasheet when entry is completed (I usually place a checkmark near the Site ID) to assist in record keeping.

**Field Screening Data Entry**

1. From the [Data Entry Switchboard] click on [Enter Field Screening Data for a Sample Event].
2. Check to make sure that your keyboard has "**Number lock**" on. This will ensure that extra records do not get entered by mistake.
3. Go to the last record entered (see Form 2). Verify [Sample Event ID] number matches the last datasheet entered. If this number is correct go to Step 4, If not correct try to determine what happened. **Do not add a new record until you have figured out what has occurred.**
4. If Site ID information has been entered into and verified for the site entry form, go to a new record in the SampleEventData form. Enter the 3-letter, 2-digit Site ID in the [Site ID] field. Select sample site type from the [Site Type] Field (Original Site, A, B, C, D, .., A 03, B03, .., A 04, B04 as verified when entering site ID information). Enter event type in [Sample Event Type] field.

**Form 2: SampleEventData**




5. Go to [Field Personnel] field and select staff names from pull-down menu. At this point the database will automatically assign a number for the [Sample Event ID]. Immediately check to make sure this agrees with the Sample Event ID assigned to this sample by filed staff. If you get a message "**cannot create record because information is required in TBL:Location**" then this site needs to be entered into the site entry form, go to Step 10.
6. Continue entering sampling information into the appropriate fields. If the sample site is **Dry** you must enter "**No**" for all three questions under **Discharge Estimation, Was a field**

**sampling conducted?** and **Lab Sample Collected.** Enter **"None"** for **QC Sample.** Enter **Date, Time** and **Referral,** leave remaining fields empty.

7. If multiple entries need to be made for any of the **Observations,** add a new record for that specific observation.
8. If sample event is for an IC/ID, select appropriate parameter from [IC/ID_Parameter] and Select a status for [Investigation_Status].
9. Enter all comments from the bottom of the field datasheet into the **Comments** box at the bottom of the database form.
10. Go back to the [Site ID] field and enter a known site ID, save record, go to back to data switchboard then to [Add a new dry weather monitoring site], and add the information needed for this sample site. Return to [Enter Field Screening Data for a Sample Event], go to the last record, change the [Site ID] to the correct ID. Continue inputting information as in Step 6.
11. If a field has not been completed on a field datasheet, circle, and note (with a post-it) inquire with field staff and correct at the next opportunity.
12. If any changes need to be made to the field datasheet, always put a line through the incorrect entry, correct and initial (I use red ink).
13. When an entry of a sample event is complete, initial and check the top of the field datasheet. Place field datasheet in binder. Save database after each entry.

**Database Maintenance Procedures**

1. Backup database once a week. Make a copy of the database and save to S:\Watershed Project\Database\msaccess\Dry Weather Database\Backup folder and date with date. **Please delete old copy of backup**.
2. Always use the Exit Button on the menu to close the database; this reduces the likelihood of database malfunctions.
3. On occasion, this database will lock-up if run on a computer that has not been re-booted. It is recommended to re-boot your computer fresh everyday if you are using the database to eliminate any problems.

# Appendix 11 - EnviroMatrix "Quality Assurance Program Manual"